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GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES XXVI

W. BLAKE, Jr.

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The present date list, GSC XXVI, is the fifteenth to be published directly in the Geological Survey's Paper series. Lists prior to GSC XII were published first in the journal **Radiocarbon** and were reprinted as GSC Papers. The lists through 1967 (GSC VI) were given new pagination, whereas lists VII to XI (1968 to 1971) were reprinted with the same pagination.

GEOLOGICAL SURVEY OF CANADA RADIOCARBON DATES XXVI

Abstract

This list presents 307 radiocarbon age determinations made by the Radiocarbon Dating Laboratory. They are on 294 geological samples from various areas as follows: Newfoundland (8); Labrador (6); Nova Scotia (4); Quebec (10); Ontario (7); British Columbia (10); Yukon Territory (16); Northwest Territories, mainland (37); Northwest Territories, Arctic Archipelago (158); Alaska (4); Greenland (30); Svalbard (10); U.S.S.R. (7). Tables 1 and 2 summarize details of background and standard for the 2 L and 5 L counters during the period from September 30, 1985 to July 31, 1986; Table 3 gives the number of counts used to determine the average background and standard counting rates; and Table 4 lists the number of different background and standard gas preparations used for counting.

Résumé

Ce rapport présente les résultats de 307 datations effectuées sur 294 échantillons géologiques par le Laboratoire de datation au radiocarbone. Ces échantillons proviennent des régions suivantes: Ile de Terre-Neuve (8); Labrador (6); Nouvelle-Ecosse (4); Québec (10); Ontario (7); Colombie-Britannique (10); Yukon (16); Territoires du Nord-Ouest, continent (37); Territoires du Nord-Ouest, archipel Arctique (158); Alaska (4); Groenland (30); Svalbard (10); U.R.S.S. (7). Tableaux 1 et 2 résument les valeurs de mouvement propre et de l'étalonnage des compteurs 2 L et 5 L, pour la période allant du 30 septembre 1985 au 31 juillet 1986; le tableau 3 donne le nombre de coups utilisés pour déterminer la moyenne des taux d'impulsions du mouvement propre et de l'étalonnage; et, le tableau 4 présente le nombre de préparations de gaz pour le mouvement propre et pour l'étalonnage utilisées pour le comptage.

INTRODUCTION[1]

During the period from September 1985 through July 1986, both the 2 L counter (Dyck and Fyles, 1962) and the 5 L counter (Dyck et al., 1965) were operated for the entire 10 months. The 2 L counter was operated at 2 atmospheres (atm) throughout the year. The 5 L counter was operated at 1 atmosphere throughout the year.

The average background and oxalic acid standard counting rates which were used for age calculations are shown in Tables 1 and 2, respectively. On a monthly basis, the counting rates were within statistical limits. Table 3 lists the number of one-day counts used to determine the average background and oxalic acid standard counting rates for the period noted above, and Table 4 gives the number of different background and (oxalic acid) standard-gas preparations used.

Sample gas preparation and purification were carried out as described in Lowdon et al. (1977). Carbon dioxide gas proportional counting techniques have been discussed by Dyck (1967). For a recent review of laboratory operations the reader is referred to Lowdon (1985).

Age calculations were done on a CDC Cyber 70 Series/Model 74 computer. Calculations are based on a ^{14}C half-life of 5568 ± 30 years and 0.95 of the activity of the NBS oxalic acid standard. Ages are quoted in radiocarbon years before 'present' (BP), where 'present' is taken to be 1950. The error assigned to each age has been calculated using only the counting errors of sample, background, and standard, and the error in the half-life of ^{14}C (Lowdon and Blake, 1973). Finite dates are based on the 2 σ criterion (95.5% probability) and 'infinite' dates on the 4 σ criterion (99.9% probability).

Table 1. Monthly average count for background during the period September 30, 1985 to July 31, 1986

Month	2 L Counter (2 atm) cpm*	5 L Counter (1 atm) cpm*
October 1985	1.404 ± 0.016	2.761 ± 0.018
November	1.357 ± 0.023	2.844 ± 0.030
December	1.471 ± 0.026	3.084 ± 0.053
January 1986	1.509 ± 0.023	3.099 ± 0.023
February	1.538 ± 0.021	3.286 ± 0.067
March	1.221 ± 0.022	2.290 ± 0.024
April	1.371 ± 0.022	2.731 ± 0.038
May	1.455 ± 0.039	2.863 ± 0.028
June	1.503 ± 0.026	2.977 ± 0.058
July	1.529 ± 0.022	3.128 ± 0.070

* cpm = counts per minute

Table 2. Monthly average count (N_o)* for oxalic acid standard during the period September 30, 1985 to July 31, 1986

Month	2 L Counter (2 atm) cpm	5 L Counter (1 atm) cpm
October 1985	18.083 ± 0.070	27.833 ± 0.087
November	18.143 ± 0.101	27.764 ± 0.124
December	18.001 ± 0.147	27.433 ± 0.133
January 1986	18.040 ± 0.097	27.940 ± 0.130
February	18.261 ± 0.097	28.114 ± 0.140
March	18.042 ± 0.097	28.213 ± 0.142
April	18.138 ± 0.096	28.247 ± 0.123
May	18.008 ± 0.098	28.154 ± 0.116
June	17.991 ± 0.101	28.202 ± 0.135
July	18.231 ± 0.097	28.199 ± 0.138

* N_o = 0.95 of the net counting rate of the NBS oxalic acid standard

[1] Data for the tables in the introduction were compiled by R.N. McNeely, Laboratory Supervisor since November 1981. The introduction follows the style developed by J.A. Lowdon. The date list has been compiled by W. Blake, Jr. from descriptions of the samples and interpretations of age determinations provided by the collectors and submitters.

Table 3. Number of one-day counts used to determine average counting rates for background and oxalic acid standard during the report period

Month	Background 2 L	Background 5 L	Standard 2 L	Standard 5 L
October 1985	8	8	5	5
November	4	4	3	3
December	7	6	3	3
January 1986	5	6	3	3
February	4	4	3	2
March	6	4	3	2
April	3	3	3	3
May	4	5	3	3
June	4	4	3	3
July	4	4	3	3

Table 4. Number of monthly background and standard gas preparations used during the report period

Month	Background 2 L	Background 5 L	Standard 2 L	Standard 5 L
October 1985	4	3	2	2
November	3	2	2	2
December	4	4	2	2
January 1986	2	3	2	2
February	3	2	2	2
March	4	2	3	2
April	2	3	1	2
May	2	2	2	2
June	2	4	2	2
July	2	4	2	2

If $^{13}C/^{12}C$ ratios were available, a correction for isotopic fractionation was applied to the sample date, and the $\delta^{13}C$ value reported. The "normal" values used for correction relative to the PDB standard are $\delta^{13}C = -25.0‰$ for wood, terrestrial organic materials, and bones (terrestrial and marine), and $0.0‰$ for marine shells. All $^{13}C/^{12}C$ determinations were made on aliquots of the sample gas used for age determinations. Since 1975 all $^{13}C/^{12}C$ ratios have been determined under contract by Professor P. Fritz and R.J. Drimmie of the Department of Earth Sciences, University of Waterloo, Waterloo, Ontario, or by Waterloo Isotope Analysts, Inc., Kitchener, Ontario (R.J. Drimmie, chief analyst) using the same equipment as at the University of Waterloo. Prior to that time some $^{13}C/^{12}C$ ratios were determined by the GSC Geochronology Section (R.K. Wanless, Head) and by Teledyne Isotopes, Westwood, New Jersey.

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Identification of materials used for dating or associated with the material being dated has been carried out by the following specialists, to whom I extend my sincere thanks: E. Perem, Forest Products Laboratory, Environment Canada, Ottawa, and R.J. Mott, L.D. Farley-Gill (L.D. Wilson), and H. Jetté (wood); N.F. Alley, Department of Mines and Energy, South Australia, Eastwood, South Australia (formerly Ministry of the Environment, Province of British Columbia, Victoria), K.D. Bennett, University of Cambridge, Cambridge, England (formerly Scarborough College, West Hill), J.B. Macpherson, Memorial University of Newfoundland, St. John's, G.A. King, University of Minnesota, Minneapolis, Minnesota, J.C. Ritchie, Scarborough College, University of Toronto, West Hill, and B.G. Warner, University of Waterloo, Waterloo (formerly Simon Fraser University, Burnaby (pollen); J.P. Smol, Queen's University, Kingston (diatoms and chrysophytes); S. Lichti-Federovich (diatoms); the late T. Edelstein, National Research Council of Canada, Halifax, and R.G. Hooper, Memorial University of Newfoundland, St. John's (marine algae); J.V. Matthews, Jr. (plant macrofossils and fossil arthropods); G.R. Brassard, University of Newfoundland, St. John's, J.A. Janssens, University of Minnesota, Minneapolis, Minnesota, and M. Kuc, formerly GSC, Ottawa (mosses); A.H. Clarke, Jr. and M.F.I. Smith, both formerly National Museum of Natural Sciences, Ottawa and A. Aitken, McMaster University, Hamilton (molluscs); E.L. Bousfield, National Museum of Natural Sciences, Ottawa (barnacles); T.M. Cronin, U.S. Geological Survey, Reston, Virginia (foraminifera and ostracods); and C.R. Harington, National Museum of Natural Sciences, Ottawa (vertebrates).

Amino acid ratios reported in this paper were carried out, under contract, at the Department of Geology, University of Alberta, Edmonton by I. Moffat, under the direction of N.W. Rutter. Accelerator mass spectrometry (AMS) ^{14}C dates were done, also under contract, at the IsoTrace Laboratory, University of Toronto, Toronto by R.P. Beukens (A.E. Litherland, Director; W.E. Kieser, Manager). G. Mizerovsky, formerly GSC, carried out a number of elevation measurements on a stereotope plotting instrument. A.C. Roberts, Mineralogy Section, made the X-ray diffraction determinations on shell samples. M. Lanoix, R.J. Richardson, J.A. Snider, J.E. Dale, and K.E. Rolko, all formerly summer students or technical assistants, assisted in the processing and examination of samples prior to their submission to the laboratory. K.E. Rolko helped extensively with the compilation of this report.

GEOLOGICAL SAMPLES

Eastern Canada

Newfoundland

Avalon Peninsula series

Lance Cove Pond (Bell Island) and the dated sites that follow (Kenny's, Oxen, and Golden Eye ponds) are all located in the eastern part of Avalon Peninsula, Newfoundland. They were cored to date specific palynostratigraphic horizons and to provide information on sedimentation rates. Dates had already been obtained from the basal organic sediment from each core.

A 482 cm-long core was obtained in a water depth of 1.5 m from Lance Cove Pond, Bell Island, Conception Bay, Newfoundland (47°36'40"N, 50°58'45"W), at an elevation of 95 m. The basal organic increment (457 to 462 cm) yielded a date of 9240 ± 190 BP (GSC-3166, GSC XXI, 1981, p. 4), which is a minimum for deglaciation. Collected October 21, 1978 by J.B. Macpherson[1], Memorial University of Newfoundland, St. John's, using a modified Livingstone corer.

GSC-4039. Bell Island, 295-300 cm — 4900 ± 110; $\delta^{13}C = -30.7‰$

Gyttja (sample LCP 295-300; 8.0 g dry) from 295 to 300 cm below the sediment/water interface.

[1] All persons referred to as collectors or submitters of samples are with the Geological Survey of Canada unless otherwise specified.

GSC-4057. Bell Island, 445-451 cm — 7680 ± 100; $\delta^{13}C = -23.9‰$

Gyttja (sample LCP 445-451; 9.9 g dry) from 445 to 451 cm below the sediment/water interface.

Comment (J.B. Macpherson): GSC-4057 confirms a very slow mean sedimentation rate at the base of the organic segment of this core, suspected from the pollen stratigraphy. GSC-4039 dates a marked temporary change in concentrations and proportions of **Abies**, which declined, and of **Picea**, which increased; the probable initial presence of the latter is dated by interpolation at 8630 BP. Mean sedimentation rates were 0.007 cm per year between 9240 and 7680 BP, increasing to 0.054 cm per year in the interval 7680 to 4900 BP, and 0.061 from 4900 BP to the present. NaOH leach was omitted from the pretreatment of both samples. Neither sample showed any reaction with HCl. Both samples were mixed with dead gas for counting. GSC-4039 is based on two 1-day counts in the 2 L counter; GSC-4057 is based on one 3-day count in the 2 L counter.

GSC-4016. Kenny's Pond, 192-197 cm — 3760 ± 80‰; $\delta^{13}C = -28.6‰$

Gyttja (sample KP 192-19 , 50.0 g wet) from 192 to 197 cm below the sediment/water interface in a 306 cm-long core, in a water depth of 2.23 m, from Kenny's Pond, St. John's, Newfoundland (47°35'25"N, 52°42'50"W), at an elevation of approximately 70 m. The basal organic increment (293 to 298 cm) yielded a date of 8570 ± 90 (GSC-3618), which is a minimum for deglaciation (GSC XXIII, 1983a, p. 4). Collected July 9, 1982 by J.B. Macpherson, using a modified Livingstone corer.

Comment (J.B. Macpherson): GSC-4016 dates the beginning of an increase in **Alnus** concentrations and proportions, together with changes in the relative representations of the main arboreal taxa. The probable initial arrival of **Picea** was dated by GSC-3618 at ca. 8570 BP. The mean sedimentation rate between 8570 and 3760 BP was 0.020 cm per year; from 3760 BP to evidence of clearance at 80 cm (ca. 200 BP) the mean rate was 0.032 cm per year. NaOH leach omitted from sample pretreatment. Sample showed no reaction with HCl. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-4066. Oxen Pond II, 295-300 cm — 7560 ± 200; $\delta^{13}C = -26.2‰$

Gyttja (sample OP II 295-300; 8.6 g dry) from 295 to 300 cm below the sediment/water interface in a 410 cm-long core, in a water depth of 1.7 m, from Oxen Pond, St. John's, Newfoundland (47°34'20"N, 52°45'50"W), at an elevation of approximately 134 m. The basal organic increment (385 to 390 cm) yielded a date of 9440 ± 360 BP (GSC-3182; GSC XXI, 1981, p. 3) which is a minimum for deglaciation. Collected November 11, 1978 by J.B. Macpherson, using a modified Livingstone corer.

Comment (J.B. Macpherson): GSC-4066 dates an increase in **Picea**, which had probably arrived at the site by an interpolated date of 8460 BP, and of arboreal birch. Mean rates of sediment accumulation were 0.048 cm per year between 9440 BP and 7580 BP, and 0.039 cm per year from 7560 BP to the present. NaOH leach omitted from the pretreatment of GSC-4066, and the sample showed no reaction with HCl. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-4015. Golden Eye Pond, 310-315 cm — 8370 ± 130; $\delta^{13}C = -18.2‰$

Gyttja (sample GEP 310-315; 17.4 g dry) from 310 to 315 cm below the sediment/water interface in a 431 cm-long core, in a water depth of 1.95 m, from Golden Eye Pond, Butterpot Provincial Park, Newfoundland (47°23'10"N, 53°03'15"W), at an elevation of approximately 208 m. The basal organic increment (419 to 424 cm) yielded a date of 10 100 ± 250 BP (GSC-3136, GSC XXI, 1981, p. 4), which is a minimum for deglaciation. Collected March 7, 1980 by J.B. Macpherson, using a modified Livingstone corer.

Comment (J.B. Macpherson): GSC-4015 dates the probable migration of **Picea** into the shrub-tundra which followed the initial sedge-tundra at this upland site. Mean sedimentation rates show little variation: 0.040 cm per year between 10 000 and 8370 BP and 0.037 cm per year from 8370 BP to the present.

In the absence of macrofossils the presence of **Picea** cannot be confirmed, but in all four cores from the Avalon Peninsula a marked increase in **Picea** pollen percentages and concentrations occurs at a level with a direct or interpolated date in the range of 8630 to 8370 BP. Given standard deviations of at least 100 years, such dates are scarcely to be distinguished (range 8820 to 8240 BP). In the Sugar Loaf Pond core, also from the eastern Avalon Peninsula, the corresponding palynostratigraphic horizon was dated by interpolation at 8300 BP (range 8450 to 8100 BP), from GSC-2601 (GSC XVIII, 1978, p. 3) and Dal-295 (Macpherson, 1982). Thus it appears that **Picea** appeared at all these sites within a very short interval, 1600 years after deglaciation at Golden Eye Pond, the earliest of the sites to become ice-free, and after a very brief period of pioneer vegetation at Kenny's Pond, the last site to be deglaciated. GSC-4039 and GSC-4106 date changes in the relative representation of arboreal taxa at the respective sites; there is as yet no evidence that these changes are of regional significance.

NaOH leach was omitted from the pretreatment of GSC-4015, and the sample showed no reaction with HCl. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3973. Freeman's Pond, 232-237 cm — 11 000 ± 260; $\delta^{13}C = -16.3‰$

Basal clay-gyttja (sample FPF 232-237; 83.2 g wet) from 232 to 237 cm below the sediment/water interface in a 258 cm-long core from Freeman's Pond, a headwater pond draining north to Fogo Harbour, 2 km south-southeast of the settlement of Fogo, Fogo Island, Newfoundland (49°42'25"N, 54°15'35"W), at an elevation of approximately 56 m. The core was obtained with a modified Livingstone sampler from the south end of the pond, apparently the only basin with sediment, in a water depth of 1.52 m. The base of the core consisted of 15 cm of silty clay overlying stony clay. Collected June 27, 1984 by J.B. Macpherson.

Comment (J.B. Macpherson): The date is a minimum for deglaciation of the site, an interpretation which is supported by the sedge-tundra pollen assemblage of the dated sediment. The site is above the reported marine limit of 36 m (Coleman, 1926). The organic sediment accumulated at a mean rate of 0.021 cm per year. With the exception of the basal date from Small Scrape Pond, Baie Verte Peninsula (10 400 ± 160 BP; GSC-3966, GSC XXV, 1986a, p. 3), GSC-3973 is the youngest terrestrial date indicative of deglaciation so far obtained from north-central Newfoundland. Other basal terrestrial dates range from

13 200 ± 300 BP (GSC-3608; Leading Tickles) to 11 300 ± 100 BP (GSC-3634; Bay d'Espoir Highway; both in GSC XXIII, 1983a, p. 4). Retreat of the main Newfoundland ice cap permitted construction of a glaciomarine delta at the head of Halls Bay after 12 000 BP (Tucker, 1974), and marine inundation of the coast of Notre Dame Bay and the Bay of Exploits was widespread between 12 000 BP and 11 000 BP (GSC XXIII, 1983a, p. 5-6). It is suggested that residual ice masses lingered in exposed locations such as the extremity of the Baie Verte Peninsula and Fogo Island during retreat of the main ice cap.

NaOH leach omitted from pretreatment of GSC-3973, and the sample showed no reaction with HCl. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

King's Point series

A 555 cm-long core of sediment was obtained from a pond with one small headwater stream, draining into Halls Bay via Indian and Davis brooks, 8.5 km west-northwest of Springdale, and 8 km south of the settlement of King's Point, Southwest Arm, Newfoundland (49°31'15"N, 56°11'45"W), at an elevation of approximately 102 m. Route 391 (71 on the topographic map) has been realigned to cross the southeastern arm of the pond; the core was obtained from the northwestern arm in a water depth of 1.56 m, as depths in the central basin were beyond the capability of the equipment. The core consisted of 536 m of gyttja grading to clay-gyttja, overlying 19 cm of gritty silty clay on a boulder or bedrock base. Collected June 24, 1984, with a modified Livingstone sampler, by J.B. Macpherson.

GSC-4003. King's Point, 490-495 cm — 10 300 ± 170; $\delta^{13}C = -30.9‰$

Gyttja (sample KPS 490-495; 63.8 g wet) from 490 to 495 cm below the sediment/water interface.

GSC-3957. King's Point, 531-536 cm — 11 800 ± 200; $\delta^{13}C = -19.5‰$

Basal clay-gyttja (sample KPS 531-536 cm; 85.5 g wet) from 531 to 536 cm below the sediment/water interface.

Comment (J.B. Macpherson): GSC-3957 is a minimum for deglaciation, an interpretation which is supported by the sedge-tundra pollen assemblage of the basal sediment. The site lies between the reconstructed ice-margins of Stages 1 and 2 of the formation of the Springdale delta, a feature which is thought to mark a significant ice-marginal stand (Tucker, 1974). The site is above the marine limit (76 m) represented by the delta top. An early stage of delta formation is dated from marine shells at 12 000 ± 220 BP (GSC-1733, GSC XXIII, 1983a, p. 6), thus GSC-3957 confirms the age of the delta.

GSC-4003 dates the initial rise in **Picea** pollen, and may indicate the very early arrival of spruce at the site, 1000 years before its probable arrival at the Compass Pond site on the Baie Verte Peninsula, some 60 km to the north (GSC XXV, 1986a, p. 2), and 2000 years before its arrival on the Avalon Peninsula of eastern Newfoundland (e.g. GSC-4015, this list). Mean sedimentation rates were 0.027 cm per year between 11 800 BP and 10 300 BP, and 0.048 cm per year from 10 300 BP to the present.

NaOH leach was omitted from the pretreatment of both samples, and neither sample reacted with HCl. Both samples were mixed with dead gas for counting. GSC-4003 is based on two 1-day counts in the 2 L counter; GSC-3957 is based on one 3-day count in the 2 L counter.

Labrador

Labrador series

The following six age determinations are from basal organic lake sediments retrieved using a modified 5 cm Livingstone corer or a 7.2 cm piston corer. For all measurements of core length, the midpoint of the interval sampled is used as the reference point and the interval itself is measured from the water surface.

Together with the Quebec series dates (this list) the dates in this series indicate minimum deglaciation times. They form part of a data set used to construct a deglaciation chronology for the southeastern part of the Labrador-Ungava peninsula (King, 1985). All those involved in collecting the cores were from the Limnological Research Center, University of Minnesota, Minneapolis, Minnesota.

GSC-3604. Pinware Lake (F), 7.10-7.16 m — 7500 ± 110; $\delta^{13}C = -21.5‰$

Silty-gyttja (sample Pw (F: 7.10-7.16 m); 143.9 g wet) 10 cm above the contact with glacial sand from Pinware Lake (unofficial name), located just interior to the coastal tundra in extreme southeastern Labrador (51°50'N, 56°35'W), at an elevation of 240 m. Collected July 21, 1981 by G.A. King and D.R. Foster.

Comment (G.A. King): GSC-3604 was intended to date deglaciation of the southeastern Labrador coast. However, the date is much younger than two other dates from the coastal area that give minimum estimates of deglaciation, SI-3137 (9820 ± 110 BP; Lamb, 1980) and GSC-2825 (10 900 ± 140 BP; GSC XIX, 1979, p. 4). The reason the date is younger than expected is unknown, although a hiatus may have occurred between the deposition of the glacial sand and the overlying organic sediment.

GSC-3661. Battery Lake (C), 6.35-6.40 m — 6980 ± 110; $\delta^{13}C = -26.9‰$

Silty-gyttja (sample Battery Lake, Core C, 6.35-6.40 m; 203.8 g wet) 15 cm above the contact with glacial silt from Battery Lake (unofficial name; 52°18'N, 62°07'W), 160 km southwest of Goose Bay, Labrador, at an elevation between 430 and 440 m. Collected July 21, 1982 by H.E. Wright and G.A. King.

Comment (G.A. King): Adjustment of GSC-3661 for the estimated age of the underlying sediments gives 7700 BP as the best estimate for the time of local deglaciation (King, 1985). The initial vegetation following deglaciation was a shrub tundra, as determined by pollen analysis (King, 1987).

GSC-3640. Leaky Lake (C), 8.10-8.18 m — 5950 ± 90; $\delta^{13}C = -27.6‰$

Silty-gyttja (sample Ly (C: 8.10-8.18 m); 286.2 g wet) 4 cm above the contact with glacial silt from Leaky Lake (unofficial name; 52°34'N, 63°36'W) 225 km east-southeast of Labrador City, and 225 km southwest of Goose Bay, Labrador, at an elevation of 580 m. Collected July 18, 1982 by H.E. Wright and G.A. King.

Comment (G.A. King): Adjustment of GSC-3640 for the estimated age of the underlying sediments gives 6100 BP as the best estimate for the time of local deglaciation (King, 1985). The initial vegetation following deglaciation was a shrub tundra as determined by pollen analysis (King, 1987).

GSC-3638. Shovel Lake C, 4.18-4.24 m — 3860 ± 70; $\delta^{13}C = -22.9‰$

Silty-gyttja (sample Sh (C: 4.18-4.24 m); 201.3 g wet) 8 cm above the contact with glacial silt from Shovel Lake (unofficial name; 52°42'N, 65°55'W) 70 km east-southeast of Labrador City, Labrador, at an elevation of 550 m. Collected July 1982 by H.E. Wright and A. Loiselle.

Comment (G.A. King): GSC-3638 is approximately two thousand years younger than the basal date at Harrie Lake (GSC-3616, 6030 ± 110 BP, this series) and is 1500 years younger than the date of the basal peat layer in a patterned fen on the south shore of the lake (WIS-1527, 5490 ± 80 BP). Thus it does not indicate the timing of local deglaciation. Perhaps there was a hiatus between the deposition of the basal glacial sediments and the overlying organic sediment that was dated, resulting in the young date.

GSC-3616. Harrie Lake (6), 11.25-11.45 m — 6030 ± 110; $\delta^{13}C = -26.2‰$

Silty-gyttja (sample Ha (G: 11.25-11.45 m); 322.7 g wet) 10 cm above the contact with glacial silt from Harrie Lake (52°56'N, 66°57'W) on the western edge of Labrador City, Labrador, at an elevation of 530 m. Collected July 1981 by H.E. Wright and G.A. King.

Comment (G.A. King): Adjustment of GSC-3616 for the estimated age of the underlying sediments gives 6200 BP as the best estimate for the time of local deglaciation (King, 1985). The initial vegetation following deglaciation was a shrub tundra, as determined by pollen analysis (King, 1987).

GSC-3625. Coghill Lake (C), 7.55-7.62 m — 5400 ± 90; $\delta^{13}C = -27.9‰$

Silty-gyttja (sample C1 (C: 7.55-7.62 m); 271.5 g wet) 27 cm above the contact with glacial silt from Coghill Lake (53°54'N, 66°46'W), 110 km north of Labrador City, Labrador, at an elevation of 530 m. Collected July 3, 1981 by H.E. Wright and G.A. King.

Comment (G.A. King): Adjustment of GSC-3625 for the estimated age of the underlying sediments gives 6200 BP as the best estimate for the time of local deglaciation (King, 1985). The initial vegetation following deglaciation was a shrub tundra, as determined by pollen analysis (King, 1987).

Comment (W. Blake, Jr.): NaOH leach omitted from the pretreatment of all six samples in this series, and none of the samples showed any reaction with HCl. Samples GSC-3604, -3616, -3625, -3640, and -3661 were mixed with dead gas for counting. GSC-3640 is based on one 3-day count in the 2 L counter. GSC-3604, -3616, -3625, -3638, and -3661 are each based on two 1-day counts in the 2 L counter.

Nova Scotia

Minas Basin series

Four samples of paired clam shells (all **Mya arenaria**; identified by J.S. Bleakney, Acadia University, Wolfville, Nova Scotia) from sites along the Kings County shore of Minas Basin, Nova Scotia.

GSC-3761. Minas Basin (I) — 160 ± 60; $\delta^{13}C = +2.0‰$

Whole paired shells (sample SAF (JSB)-10.82; 47.5 g; **Mya arenaria**) from a grey clay layer on the west bank of The Guzzle, where it cuts between Long Island and Boot Island, Nova Scotia (45°08.3'N, 64°17.4'W), at an elevation of 0.25 m above mean sea level. Collected October 1982 by S.A. Ferguson, Wolfville, Nova Scotia.

GSC-3768. Minas Basin (II) — 3310 ± 60; $\delta^{13}C = +0.8‰$

Whole paired shells (sample JSB-18.8.83(2); 45.3 g; **Mya arenaria**) from a grey clay layer on a wide, gently sloping section of the west bank of The Guzzle, northeast of Evangeline Beach, Nova Scotia (45°09'N, 64°17.6'W), 1.8 m below mean sea level. Collected August 17, 1983 by J.S. Bleakney and S.A. Ferguson.

GSC-3714. Minas Basin (III) — 1890 ± 50; $\delta^{13}C = +1.5‰$

Whole paired shells (sample JSB-17.8.83(1); 44.8 g; **Mya arenaria**) from a grey clay layer on the bank of a stream in The Guzzle, on the intertidal flats north of Evangeline Beach, Nova Scotia (45°09.2'N, 64°17.8'W), 2.45 m below mean sea level. This bed is exposed for approximately 20 to 25 m and may continue westward under a 1 to 1.5 m-thick overburden. Collected August 17, 1983 by J.S. Bleakney and S.A. Ferguson.

GSC-3713. Minas Basin (IV) — 750 ± 50; $\delta^{13}C = +1.6‰$

Whole paired shells (sample JSB-8.12.82; 47.6 g; **Mya arenaria**) from an exposed red sandy clay bed overlain by 6 m of layered sediments. The sampled bed extends along 100 m of the Cornwallis River bank at Wolfville, Nova Scotia (45°06'N, 64°21.6'W), 0.28 m below mean sea level. Collected December 8, 1982 by J.S. Bleakney and S.A. Ferguson.

Comment (J.S. Bleakney): It is evident that periodically (at intervals of 500 to 1400 years) catastrophic events in Minas Basin bury beds of molluscs in the paired, upright, in situ state, and that these molluscs have remained undisturbed until the present time. Analysis of the entombing sediments may provide clues to these events. The time period involved of nearly 4000 years encompasses much of the evolutionary period of the megatides of Minas Basin. The **Mya arenaria** samples thus represent populations of soft-shelled clams that grew in distinctly different environments of increasing tidal amplitude, decreasing temperature, and increasing salinity and turbidity. The **Mya** collections are presently being analysed to determine differences in growth rate, maximum size, and age. The date of 160 ± 60 BP for GSC-3761 is most unexpected as tree stumps nearby exceeded 3000 BP (Bleakney and Davis, 1983; GSC XXV, 1986a, p. 6-7).

Comment (W. Blake, Jr.): GSC-3713, -3714, and -3768 are each based on two 1-day counts in the 5 L counter; GSC-3761 is based on one 1-day count in the 5 L counter.

Quebec

Quebec series

The following 10 dates are from basal organic lake sediments retrieved using a modified 5 cm Livingstone corer or a 7.2 cm piston corer. For all measurements of core length, the midpoint of the interval sampled is used as the reference point and the interval itself is measured from the water surface.

The dates in this series are from sites situated north and northwest from Sept-Iles and, together with the Labrador Series dates (this list), they document the retreat of ice from the Gulf of St. Lawrence to the interior of the peninsula. All those involved in coring are from the Limnological Research Center, University of Minnesota, Minneapolis, Minnesota.

GSC-3716. Lac Pétel (B), 7.17-7.23 m — 7710 ± 90; $\delta^{13}C = -25.8‰$

Silty-gyttja (sample Lac Pétel, Core B, 7.17-7.23 m; 264.8 g wet) 6 cm above the contact with glacial silts and clays from Lac Pétel (50°33'N, 66°16'W), 40 km north of

Sept-Iles, Québec, at an elevation of 270 m. One hundred glacial varves are present below the contact of organic sediment and the inorganic glacial sediments. Collected June 19, 1982 by G.A. King and D.R. Foster.

Comment (G.A. King): Adjustment of GSC-3716 for the estimated age of the underlying sediments gives 8100 BP as the best estimate for the time of local deglaciation (King, 1985). The date also gives a minimum age for the Quebec North Shore Moraine System (Dubois and Dionne, 1985). The presence of spruce needles at 7.23 m indicates that spruce trees colonized the watershed shortly after deglaciation. Pollen data indicate that the vegetation at this time was a forest tundra (King, 1987).

GSC-3720. Lac au Sable (A), 9.48-9.53 m — 6860 ± 100; $\delta^{13}C = -26.1‰$

Silty-gyttja (sample Lac au Sable, Core A, 9.48-9.53 m; 164.2 g wet) 8 cm above the contact with glacial silt from Lac au Sable (51°24'N, 66°13'W), 130 km north of Sept-Iles, Quebec, at an elevation of 530 m. Collected June 24, 1982 by G.A. King and D.R. Foster.

Comment (G.A. King): Adjustment of the date for the estimated age of the underlying sediments gives 7200 BP as the best estimate for the time of local deglaciation (King, 1985). The initial vegetation following deglaciation was a shrub tundra, as determined by pollen analysis (King, 1987).

GSC-3615. Lac Gras A, 9.66-9.78 m — 6510 ± 110; $\delta^{13}C = -29.2‰$

Silty-gyttja (sample Gr (A: 9.66-9.78 m); 149.6 g wet) 8 cm above the contact with glacial silt from Lac Gras, Quebec (52°15'N, 67°04'W), 75 km south of Labrador City, Labrador, at an elevation of 530 m.

Comment (G.A. King): Adjustment of the date for the estimated age of the underlying sediments gives 6900 BP as the best estimate for the time of local deglaciation (King, 1985). The initial vegetation following deglaciation was a shrub tundra, as determined by pollen analysis (King, 1987).

GSC-3644. Lac Stakel, 9.03-9.08 m — 6200 ± 100; $\delta^{13}C = -23.8‰$

Silty-gyttja (sample Stakel Lake (9.03-9.08 m); 198.4 g wet) 7 cm above the contact with glacial silt from Lac Stakel, Quebec (52°41'N, 67°37'W), 55 km west-southwest of Labrador City, Labrador, at an elevation of 640 m. Collected July 1982 by H.E. Wright, Jr.

Comment (G.A. King): Adjustment of the date for the estimated age of the underlying sediments gives 6300 BP as the best estimate for the time of local deglaciation (King, 1985).

GSC-3626. Bruce Lake (F), 6.99-7.04 m — 4150 ± 150; $\delta^{13}C = -25.3‰$

Silty-gyttja (sample BR (F: 6.99-7.04 m); 159.7 g wet) 16 cm above the contact with glacial silt from Bruce Lake, Quebec (53°17'N, 66°50'W), 30 km north of Labrador City, Labrador, at an elevation of 580 m. Collected July 2, 1981 by H.E. Wright and G.A. King.

Comment (G.A. King): GSC-3626 is two thousand years younger than the basal date at Harrie Lake (GSC-3616, 6030 ± 110 BP, this list) only 30 km to the south, and thus does not indicate the timing of local deglaciation. The reason that the date is too young is unknown, although contamination by modern fungal or bacteria growth or a hiatus in the core between the glacial silt and organic sediments are two possible explanations for this anomalous date.

GSC-3658. Horseshoe Lake, 6.53-6.60 m — 5770 ± 70; $\delta^{13}C = -27.6‰$

Silty-gyttja (sample Horseshoe Lake (6.53-6.60 m); 211.7 g wet) 31 cm above the contact with glacial silt from Horseshoe Lake (unofficial name), Quebec (53°17'N, 67°42'W), 65 km northwest of Labrador City, Labrador, at an elevation of 620 m. Collected July 1982 by H.E. Wright.

Comment (G.A. King): GSC-3658 does not provide an accurate estimate for the time of local deglaciation as the dated sediment is 31 cm above the glacial sediments. No reasonable adjustment could be made to the date, as there is not another date above the basal date that would allow calculation of the sedimentation rate for the base of the core. Without an estimated sedimentation rate, the age of the organic sediments below the basal date cannot be approximated.

GSC-3629. Lac Ridge (A6), 12.92-12.97 m — 8780 ± 140; $\delta^{13}C = -31.9‰$

Silty-gyttja (sample Ri(A,6: 12.92-12.97 m); 132.1 g wet) 4 cm above the contact with glacial silt from Lac Ridge (54°51'N, 66°55'W), 9 km northwest of Schefferville, Quebec, at an elevation of 500 m. Collected July 8, 1981 by G.A. King and M. Kelleher.

Comment (G.A. King): Geologic evidence of the pattern of final wastage of the Laurentide Ice Sheet indicates that ice persisted the longest in the Schefferville area (Ives, 1960) and in a region 100 km west of Schefferville (Hughes, 1964; Richard et al., 1982). Dates indicating local deglaciation from sites 100 to 200 km from Schefferville (GSC-3052, 5490 ± 80 BP; GSC-3094, 6320 ± 180 BP, Richard et al., 1982; GSC-3252, 6420 ± 150 BP, GSC-3241, 6500 ± 100 BP, Lamb, 1985; see King, 1985; all dates in GSC XXII, 1982a, p. 3-6) indicate that final wastage of ice must have occurred after 6500 BP. Thus GSC-3629, from one of the regions where ice persisted the longest, is several thousand years too old.

Other basal dates from the Schefferville area are also too old, for instance, those from Boundary Lake (GX-5520, 10 700 ± 540 BP; QL-1214, 9980 ± 40 BP; and QL-1214B, 16 330 ± 330 BP; Stravers, 1981) which is located about 60 km north of Schefferville.

There are several possible explanations for the old dates in the Schefferville region. The likeliest one is that the sediment is contaminated with old carbon, derived from the surrounding sedimentary bedrock (Stravers, 1981; King, 1985). Most of the other dates from the Labrador-Ungava Peninsula are on highly metamorphosed rock (Greene, 1974) and thus contamination of the dated sediments by old carbon is less likely.

GSC-3595. Pine Lake, 10.85-10.89 m — 6450 ± 90

Silty-gyttja (sample Pine Lake (10.85-10.89 m); 144.0 g wet) 6 cm above the contact with glacial silt from Pine Lake (unofficial name, 51°08'N, 69°16'W) 225 km northwest of Sept-Iles, Quebec, at an elevation of 460 m. Collected July 1982 by H.E. Wright.

Comment (G.A. King): Adjustment of the date for the estimated age of the underlying sediments gives 6600 BP as the best estimate for the time of local deglaciation (King, 1985).

GSC-3551. Lac de la Crête, 10.37-10.42 m — 5200 ± 110; $\delta^{13}C = -26.3‰$

Silty-gyttja (sample Lac de la Crête; 10.37-10.42 m; 114.6 g wet) below the water surface (10 m water depth) and 6 cm above the contact with glacial silt from Lac de la Crête

(50°59'N, 69°53'W), 40 km southwest of Pine Lake and approximately 275 km northwest of Sept-Iles, Quebec, at an elevation of 670 m. Collected July 1982 by H.E. Wright.

GSC-3551 is over 1200 years younger than the basal date at Pine Lake (GSC-3595, 6450 ± 90, this series), only 40 km to the northeast. However, Lac de la Crête is two hundred meters higher than Pine Lake and ice may have persisted longer in this highland area than it did at lower elevations. Thus this date could reasonably indicate the wastage of ice in this highland area.

GSC-3569. Lac Éluard, 16.35-16.45 m — 6010 ± 90, $\delta^{13}C = -27.1‰$

Silty-gyttja (sample Cove Lake (16.35-16.45 m); 150.7 g wet) an unknown distance above the contact with glacial sediments from Lac Éluard (50°21'N, 70°52'W), approximately 285 km west-northwest of Sept-Iles, Quebec, at an elevation of 530 m. Collected July 1982 by H.E. Wright.

GSC-3569 is from sediment an unknown distance above the glacial sediments, so an estimate of the local deglaciation time cannot be made for this site. Deglaciation could have occurred several thousand years prior to the deposition of the dated sediment. Support for this statement comes from pollen analysis of the dated sediments that show that spruce was present in the surrounding watershed when those sediments were deposited. The initial vegetation following deglaciation in this region is usually a shrub tundra (King, 1987), and as sediments containing a record of the shrub tundra were not recovered, it is likely that the date is much younger than the time of local deglaciation.

Comment (W. Blake, Jr.): NaOH leach was omitted from the pretreatment of all ten samples in this series, and none of the samples showed any reaction with HCl. Samples GSC-3551, -3595, -3615, -3626, -3644, and -3720 were mixed with dead gas for counting. GSC-3615 and -3658 are each based on one 3-day count in the 2 L counter. GSC-3551, -3569, -3595, -3626, -3629, -3644, -3716, and -3720 are each based on two 1-day counts in the 2 L counter.

Ontario

Lac Bastien series

A series of lake sediment samples were extracted from a 450 cm-long core tube in 8.8 m of water in Lac Bastien, a small (7.8 ha) lake 2 km west of Highway 533 and 18 km northwest of Mattawa, Ontario (46°24'N, 78°55'W), at an elevation of 305 m. Collected January 29-30, 1985 by K.D. Bennett (then Scarborough College, University of Toronto, West Hill, Ontario; now University of Cambridge, Cambridge, England) and J.C. Ritchie, Scarborough College, using a modified Livingstone corer.

GSC-4142. Lac Bastien, 117-123 cm — 2000 ± 80

Gyttja (sample Lac Bastien B 997-1003 cm; 88.1 g wet) from 117 to 123 cm below the sediment/water interface. This sample dates the second maximum of **Tsuga** pollen frequencies following the mid-Holocene decline.

GSC-4130. Lac Bastien, 207-213 cm — 3220 ± 100, $\delta^{13}C = -30.4‰$

Gyttja (sample Lac Bastien B 1087-1093 cm; 85.8 g wet) from 207 to 213 cm below the sediment/water interface. This sample dates the minimum of **Tsuga** pollen frequencies and the maximum of **Betula** pollen frequencies. Uncorrected age: 3300 ± 100 BP.

GSC-4112. Lac Bastien, 299-305 cm — 5140 ± 90, $\delta^{13}C = -30.3‰$

Gyttja (sample Lac Bastien B 1179-1185 cm; 89.5 g wet) from 299 to 305 cm below the sediment/water interface. This sample dates the beginning of the **Tsuga** decline, a rise in **Betula** and **Thuja** pollen frequencies, and the decline of **Pinus** pollen frequencies. Uncorrected age: 5220 ± 90 BP.

GSC-4094. Lac Bastien, 387-393 cm — 7530 ± 110

Gyttja (sample Lac Bastien B 1267-1273 cm; 88.0 g wet) from 387 to 393 cm below the sediment/water interface. This sample dates falling pollen frequencies of **Betula** and an increase of **Pinus strobus**. It also dates the end of the phase of relatively high **Abies** pollen frequencies and marks the disappearance of **Picea** from near the site.

GSC-4085. Lac Bastien, 479-485 cm — 9420 ± 120, $\delta^{13}C = -30.9‰$

Gyttja (sample Lac Bastien B 1359-1365 cm; 89.6 g wet) from 479 to 485 cm below the sediment/water interface. This sample dates the beginning of organic sedimentation in Lac Bastien. The pollen spectra are dominated by **Picea** and **Pinus banksiana/resinosa**, with **Thuja/Juniperus**, **Myrica**, **Betula** and **Quercus**. Uncorrected age: 9520 ± 120 BP.

Comment (K.D. Bennett): The five dates from the sediments of Lac Bastien demonstrate that there is a linear age-depth relationship, with a sediment accumulation rate of 21.3 yr cm^{-1}, constant throughout the Holocene. The site is being used as one of a series in southern Ontario to investigate the early Holocene spread and expansion of **Fagus grandifolia**.

Comment (W. Blake, Jr.): NaOH leach was omitted from the pretreatment of all five samples, and none of them showed any reaction with HCl. Each sample was mixed with dead gas for counting. Each date is based on two 1-day counts in the 2 L counter except GSC-4085, which is based on one 4-day count in the 2 L counter.

Sunfish Lake series

Two samples, wood and gyttja, were taken from a 485 cm-long core from Sunfish Lake, 8 km west of Waterloo, Ontario (43°29'N, 80°39'W), at an elevation of 365 m. The water depth at the coring site was approximately 20 m. The main plug of wood occurred at a depth of 330 to 345 cm in the core, embedded in silty gyttja, but pieces of the wood extended between 329 and 348 cm. The lake was cored August 22, 1978 by S.R. Brown, Queen's University, Kingston, using a modified Livingstone corer.

GSC-3535. Sunfish Lake, 339-348 cm — 8080 ± 140, $\delta^{13}C = -28.8‰$

Wood (sample SRB-78-SF (339-348 cm); 3.7 g dry; **Populus** sp.; unpublished GSC Wood Identification Report No. 82-24 by R.J. Mott). Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3655. Sunfish Lake, 326-338 cm and 350-358 cm — 10 400 ± 110, $\delta^{13}C = -32.4‰$

Silty gyttja (sample SRB-78-SF (326-338; 350-358 cm); 112.1 g dry) from above and below a piece of wood (GSC-3535). The small diameter of the core (5 cm) and the low content of organic carbon (1.06 to 4.12%) necessitated using a large vertical interval. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Comment (J.P. Smol, Queen's University): The wood sample occurs in the middle of the pine (**Pinus**) pollen zone, near a transition from organic to more silty and sandy sediment. The lake is presently meromictic, and the sediment core is finely laminated throughout most of its length.

Comment (W. Blake, Jr.): The date on organic lake sediment, albeit on a much larger vertical increment that is desirable, is similar to one of 10 550 ± 220 years (I-4652) obtained for the interval 350 to 360 cm in another core from Sunfish Lake (Sreenivasa, 1973; Sreenivasa and Duthie, 1973). The material used for GSC-3655 showed a strong reaction with HCl. NaOH omitted from the pretreatment of both samples.

Western Canada

British Columbia

Serendipity Lake series

A series of samples was extracted from a 326 cm-long core from a boggy peninsula extending out into Serendipity Lake, 5.5 km south-southeast of Tow Hill on the Argonaut Plain of northeastern Graham Island, Queen Charlotte Islands, British Columbia (54°01.6'N, 131°45.6'W), at an elevation of approximately 75 m. The bog basin is developed on well-sorted sand which characterizes much of the sediment underlying the bogs and lakes on the Argonaut Plain. The sampled peat had an average carbon content of approximately 50%. Pollen and plant macrofossil analyses have been carried out by B.G. Warner (Warner, 1984). All measurements were made from the sediment/water interface. Collected July 11, 1981 by R.W. Mathewes, Simon Fraser University, Burnaby, British Columbia, and B.G. Warner, then Simon Fraser University, now University of Waterloo, Waterloo, Ontario, using a 5 cm diameter Livingstone corer.

GSC-3707. Serendipity Lake 1, 65-70 cm — 2390 ± 100; $\delta^{13}C = -27.9‰$

Coarse limnic peat (sample Serend. 1 65-70 cm; 36.4 g wet) with **Sphagnum**, monocot leaves and rhizomes, and fragments of heath shrubs. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3599. Serendipity Lake 1, 135-140 cm — 5810 ± 90; $\delta^{13}C = -27.9‰$

Dar, humus-rich detrital peat (sample Serend. 1 135-140 cm; 50.0 g wet) with abundant monocot remains, frequent **Sphagnum** leaves and twig fragments. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3583. Serendipity Lake 1, 195-200 cm — 6230 ± 80; $\delta^{13}C = -28.1‰$

Limnic peat (sample Serend. 1 195-200 cm; 72.2 g wet) with twig fragments, some remains of pleurocarpous mosses, and scattered silt and sand. Date is based on two 1-day counts in the 2 L counter.

GSC-3568. Serendipity Lake 1, 275-280 cm — 8470 ± 90; $\delta^{13}C = -29.8‰$

Limnic peat (sample Serend. 1 275-280 cm; 98.7 g wet) with twig fragments, pleurocarpous mosses, and scattered silt and sand. Date is based on two 1-day counts in the 5 L counter.

GSC-3353. Serendipity Lake 1, 319.5-326 cm — 8400 ± 80; $\delta^{13}C = -29.7‰$

Limnic peat (sample Serendipity Lk. 319.5-326 cm; 110.6 g wet) with abundant sand, overlying iron-stained sand. Date is based on one 3-day count in the 5 L counter.

Comment (R.W. Mathewes): The core was collected primarily to provide a history of vegetation and climate in the area (Warner, 1984). The basal sample, GSC-3353 at 319.5-326 cm depth, is statistically not older than sample GSC-3568 at 275 to 280 cm depth. This suggests that the basal material may have been intruded by roots of plants growing on top of GSC-3568. A similar problem is not apparent from a plot of depth versus age for the other four samples in the series (Warner, 1984, Fig. 17). Using palynological correlation with the dated profile from Boulton Lake (this list), the real age at the base of the Serendipity Lake core is placed at about 9400 BP (Warner, 1984). The sediments, pollen, and macrofossils suggest a succession from a shallow lake, to a sedge meadow or fen at 8300 BP to increasingly boggy conditions with **Sphagnum** and heath plants after 5810 ± 90 BP (GSC-3599). NaOH leach was omitted from the pretreatment of all samples.

Boulton Lake series

A series of samples was extracted from a core from Boulton Lake, 12.5 km north of Port Clements, at the western edge of the Queen Charlotte Lowlands near Masset Inlet, Graham Island, British Columbia (53°47'N, 132°06'W), at an elevation of 65 m. This 'bog-lake' was selected for paleoecological analysis because of its moderate size (24 ha) and shallow depth (a maximum of 4 m) which permitted easy coring from a pair of anchored boats. Lake sediments containing approximately 40% carbon make up the bulk of the core. All measurements were made from the sediment/water interface. Collected July 4, 1981 by R.W. Mathewes and B.G. Warner using a 5 cm-diameter modified Livingstone corer.

GSC-3512. Boulton Lake, 35-40 cm — 2700 ± 80; $\delta^{13}C = -29.0‰$

Limnic peat (sample Boulton Lk. 35-40 cm; 133.8 g wet). Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3489. Boulton Lake, 135-140 cm — 5430 ± 90; $\delta^{13}C = -29.5‰$

Limnic peat (sample Boulton Lk. 135-140 cm; 55.4 g wet). Date is based on two 1-day counts in the 2 L counter.

GSC-3484. Boulton Lake, 194-199 cm — 7400 ± 140; $\delta^{13}C = -31.3‰$

Limnic peat (sample Boulton Lk. 194-199 cm; 65.0 g wet). Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3474. Boulton Lake, 265-270 cm — 9440 ± 90; $\delta^{13}C = -26.8‰$

Limnic peat (sample Boulton Lk. 265-270 cm; 81.6 g wet). Date is based on one 3-day count in the 5 L counter.

GSC-3329. Boulton Lake, 302-307 cm — 9900 ± 100; $\delta^{13}C = -27.8‰$

Basal limnic peat (sample Boulton Lk. 302-307 cm; 79.2 g wet). Date is based on one 3-day count in the 2 L counter.

Comment (R.W. Mathewes): This core has been analyzed for pollen and macrofossils by B.G. Warner. The dates were used to generate a time scale for pollen influx

measurements and to date certain events of interest in the pollen diagrams. GSC-3329 is a minimum age for deglaciation of the western edge of the Queen Charlotte Lowlands. Herb-dominated pollen spectra give way about 500 years later (GSC-3474) to coniferous forest dominance. GSC-3484 marks the time of first consistent appearance of Cupressaceae pollen, a type of particular interest. Red cedar (**Thuja plicata**) is a major Cupressaceae pollen contributor, and this species is of archaeological and paleoclimatic interest (Hebda and Mathewes, 1984). GSC-3489 marks the beginning of a Cupressaceae pollen increase to 5 to 15%, although the most dramatic increase occurs just prior to GSC-3512, at around 3100 BP (20 to 48%). The uppermost sample, GSC-3512, is surprisingly old, considering its depth of only 35 to 40 cm. Warner (1984) ascribed the low sediment accumulation rates at the top of the core to unproductive, dystrophic waters associated with bog expansion around the lake. NaOH leach was omitted from the pretreatment of all samples.

Northern Canada, mainland

Yukon Territory

GSC-3398. Burwash Creek 3450 ± 100

Wood (sample JBC-81-Burwash; 5.1 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 81-38 by R.J. Mott) from the wall of a 3.0 m deep and 2.1 m wide trench near Burwash Creek, Alaska Highway, Yukon Territory (61°21'N, 139°15'W), at an elevation of approximately 810 m. The wood was extracted from a layer of ice 1.5 m below the surface. Collected February 28, 1981 by J.B. Cook and J. de Lestard, Yukon Lands and Forest Service, Whitehorse, Yukon Territory.

Comment (W. Blake, Jr.): Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3952. Mackintosh Creek 7600 ± 110

Gyttja (sample PR-3-46 (180-182.5 cm); 14.0 g dry) together with mollusc-bearing sand from the base of 1 115 cm-long core of frozen gyttja grading downward to sandy gyttja in the Mackintosh Creek area, 19.1 km northeast of Aishihik airport, Yukon Territory (61°45'08"N, 137°12'43"W), at an elevation of 1040 m. The gyttja layer is overlain successively by 4 cm of oxidized sand, 22 cm of organic silt with molluscs in life position, 18 cm of bioturbated and cryoturbated sand and diffused White River ash, and 20 cm of sand, roots and litter. The sample was from 180 to 182.5 cm below the ground surface and 40 cm above lake level. The collection site is a bank between two lakes showing evidence of thermokarst erosion. Collected August 4, 1984 by M.-A. Geurts and H. Beaudet, both from l'Université de Ottawa, Ottawa, Ontario.

Comment (H. Beaudet): The sample was dated to obtain the age at the base of a profile for palynological analysis. The collection site is approximately 3.5 km north (down-glacier) of a hummocky moraine belt (McConnell Till) in the Aishihik Lake area (cf. GSC-749, 9660 ± 150 BP; GSC IX, 1970, p. 75). Accordingly, the site could have provided a complete post-glacial and Holocene (or longer) pollen record. The incomplete record can in part be explained by the technically limited coring depth: the gyttja layer may not have been sampled to its stratigraphic base (Beaudet, 1986).

Comment (W. Blake, Jr.): The wet sample, including water, weighed 97.8 g. After overnight oven drying the weight was reduced to 25.0 g. After the sample was processed for plant macrofossils and fossil arthropods the sample weight was reduced to 14.0 g. A few seeds of **Potomogeton filiformis** and **Myriophyllum spicatum** were present as well as abundant oogonia of **Chara** sp. (unpublished GSC Plant Macrofossil Report No. 84-35 by J.V. Matthews, Jr.). The greater than 80 mesh residue contained abundant pelecypods and ostracods, a few gastropods, statoblasts of **Cristatella mucedo**, and **Daphnia ephippia** (unpublished GSC Fossil Arthropod Report No. 84-35 by J.V. Matthews, Jr.). NaOH leach omitted and the sample reacted slightly with HCl. Date is based on one 3-day count in the 2 L counter.

Yukon River series

Wood samples from two sites along the Yukon River were collected as part of a study of river history.

GSC-3971. Yukon River (I) 4750 ± 60
$\delta^{13}C = -25.4‰$

Wood (sample HHF-84-246; 11.4 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 85-9 by H. Jetté) approximately 8 km downstream from the confluence of Big Salmon River and Yukon River, Yukon Territory (61°55'30"N, 135°00'30"W), at an elevation of 570 m. The sample was taken from the freshly exposed part of a 12 cm diameter stick, 4.8 m above river level, in sand. Collected August 2, 1984 by E.A. Fuller, Department of Geography, Simon Fraser University, Burnaby, British Columbia.

Comment (E.A. Fuller): The sample dates a 6.4 m-high terrace containing gravel below 4.7 m and rhythmically bedded sand up to 6.2 m.

The section is capped by volcanic ash. The terrace is part of a continuous exposure of a fining-upward sequence with bedding characteristics suggesting lateral migration to the north. The alluvial surface undulates from a maximum height of 9.1 m, where it abuts a 16 m high retreatal outwash terrace, down to 1.5 m, where it becomes the contemporary scrolled floodplain.

A white volcanic ash layer 15 to 20 cm-thick is continuously exposed near the top of the 1000 m-long cutbank and is identified as White River Ash (East Lobe), dated at about 1250 BP (Lerbekmo et al., 1975). The ash layer is buried by fluvial sands on surfaces below 4 m. On a 3 m-high floodplain the ash is buried by 40 cm of fine sand. The ash layer is absent on the outer 200 m of floodplain 1.5 to 1.8 m above river level.

It is concluded that the Yukon River has migrated 200 m over the last 1250 years based on the White River Ash time marker (0.16 m/yr) and has migrated 1100 m to the north in about 4800 years based on the radiocarbon age reported here (0.23 m/yr). During the last 4800 years the alluvial surface has dropped from 6.4 m to 1.5 m (1 mm/yr; Fuller, 1986).

Extrapolating back to the highest fining-upwards terrace suggests that the Yukon River, between the outlet of Walsh Creek and 7 km downstream, has behaved as a meandering river for the last 5600 years. Previous to 5600 BP a braided type of river or outwash fan was present following retreat of McConnell ice from the Yukon River valley possibly 15 000 years BP.

Comment (W. Blake, Jr.): The single largest piece of wood in this sample was 28 cm long and 6.5 x 5.0 cm in cross-section (maximum size). Both ends were worn. Date is based on two 1-day counts in the 5 L counter.

GSC-4012. Yukon River (II) 1210 ± 60
$\delta^{13}C = -26.7‰$

Wood (sample HHF-84-116; 11.7 g dry; tentatively identified as **Picea** sp.; unpublished GSC Wood Identification Report No. 85-1 by R.J. Mott) from a 10 cm-diameter stick at least 1 m long, exposed in a cutbank on a 400 m-long island 1.15 km downstream from the confluence of Williams Creek on Yukon River, Yukon Territory (62°24'06"N, 136°37'24"W), at an elevation of approximately 475 m. The sample was enclosed in a volcanic ash layer 2 m above river level in a 2.6 m-high cutbank. Collected July 1984 by E.A. Fuller.

Comment (E.A. Fuller): The enclosing ash lies within the East Lobe of White River Ash which has fallen on a pre-existing island. This island has subsequently been flooded and partially eroded. Several other islands are partially underlain by tephra in the reach between Yukon Crossing and Minto. Islands usually considered ephemeral features are evidently older than White River Ash in parts of this reach (Fuller, 1986). The White River Ash therefore provides a precise time marker for measuring island growth and destruction along the Yukon River within the lobe mapped by Bostock (1952).

Comment (W. Blake, Jr.): The date is similar to several other determinations related to the East Lobe of the White River Ash: GSC-408 (1200 ± 140 BP), GSC-343 (1240 ± 130 BP, both in GSC VII, 1968, p. 230), GSC-748 (1210 ± 130 BP), GSC-934 (1280 ± 130 BP), and GSC-1000 (1300 ± 130 BP; all three in GSC IX, 1970, p. 80). The sample used for GSC-4012 was 15 small pieces, all from a single stick. The maximum length of the rather rotten pieces received was 6 cm; maximum diameter, 3 x 2 cm. The sample was air dried and visible rootlets were removed by hand. Date is based on two 1-day counts in the 2 L counter.

GSC-1925. White River >50 000
$\delta^{13}C = -25.9‰$

Compressed twigs (sample BS-72-19; 54.0 g) from an exposure along the White River, 1.9 km downstream from the bridge over the Alaska Highway at Mile 1171.1 (km 1873.8), Yukon Territory (62°0.5'N, 140°34'W), at an elevation of 730 m. The twigs came from a discontinuous debris-bearing layer (maximum thickness, 15 cm) overlying mudflow debris and overlain by Macauley till. A volcanic ash was also present with the organic debris. The site was at the south end of this section along the White River and less than 4.5 m above river level. Collected August 12, 1972 by W. Blake, Jr.

Comment (W. Blake, Jr.): Radiocarbon age determinations previously available from this section were: GSC-552 (>42 000; GSC IX, 1970, p. 79) on decayed peat to the north in the same section; GSC-995 (>41 000; GSC IX, 1970, p. 79) on compressed twigs and peat below the point at which GSC-1925 was collected; and GSC-1579 (>40 000; GSC XIII, 1973, p. 30) on organic silt beneath Macauley Till a shorter distance to the north (cf. Fig. 5 in Hughes et al., 1972). The result on GSC-1925, one of several determinations at 'high pressure' on organic debris from this area, comes closer to eliminating the possibility that mid-Wisconsinan materials underlie till of the Macauley glaciation. Other dates obtained nearby were GSC-732 (48 000 ± 1300; GSC IX, 1970, p. 79) on wood in mudflow debris, and GSC-1615 (>48 000; GSC XIII, 1973, p. 30) on organic silt (cf. Denton and Stuiver, 1967; Rampton, 1971).

The twigs, the largest of which was 5.5 cm long and 0.5 cm in diameter, were picked from the bulk sample of organic detritus by M. Lanoix and W. Blake, Jr. Sample pretreatment included a 1-hour leach in hot HCl, a 1-hour leach in hot NaOH, and distilled water rinses. Date is based on one 3-day count and two 1-day counts in the 5 L counter at 4 atmospheres.

GSC-3507. Clear Creek 6230 ± 80

Wood (sample FI-82-1; 13.7 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 82-33 by R.J. Mott) from a 30 cm-thick lens of sand enclosed in approximately 5 m of poorly sorted gravel which overlies rock in a placer cut in flood plain sediments of Clear Creek (63°46"55'N, 137°31"50'W), 20 km north of Stewart River, Yukon Territory. The sand underlies 2 m of overbank sand and silt. Collected July 27, 1982 by S. Morison, Department of Indian and Northern Affairs, Whitehorse, R.J. Fulton, and O.L. Hughes.

Comment (R.J. Fulton): It is not certain whether this part of Clear Creek drainage was ever glaciated, but it definitely was not glaciated during the Wisconsinan. Consequently the age of the gravels, which contain gold values, was uncertain. This date indicates that the gravels are of Holocene age.

Comment (W. Blake, Jr.): The wet wood, which originally was 33 cm long and had a maximum diameter of 5 cm, was dried overnight in an electric oven; the weight decreased from 84.4 to 13.7 g. Date is based on one 3-day count in the 5 L counter.

Bluefish Exposure (HH75-24) series

Wood and organic detritus from an alluvial sequence at the "Bluefish Exposure" (informal name)(=HH75-24 and MiVn-4) at an elevation of approximately 304 m (top) and located in the Bluefish Basin on the Bluefish River, Yukon Territory (67°23.1'N; 140°21.7'W) approximately 31 km southwest of the village of Old Crow and just downstream of the Twin Lake outlet. Collected July 11 and 23, 1976 by R.E. Morlan (National Museum of Man, Ottawa; new name, National Museum of Civilization).

GSC-3946. Bluefish Exposure, detritus 20 800 ± 200

Organic detritus (sample REM-76-113; 35.0 g dry), consisting mostly of small woody stem fragments isolated from the sample by sieving (>40 mesh). The sample was located at the 39.2 m level at Station 2 of the exposure. Some of the larger wood fragments possessed slightly rounded ends, indicating that they may be rebedded.

GSC-2373. Bluefish Exposure, wood (I) >43 000

Wood (sample NMC-863; 11.8 g dry; **Picea** sp.; unpublished GSC Wood Identification Report 76-28 by L.D. Farley-Gill) from an overturned tree trunk, approximately 22 cm in diameter. Although not in growth position the tree is thought to be penecontemporaneous with enclosing alluvial sediments because it contains both bark and delicate branches (R.E. Morlan, personal communication, 1983). Date is based on one 4-day count in the 5 L counter.

GSC-2373-2. Bluefish Exposure, wood (II) 51 900 ± 1350

Wood (sample NMC-863; 45.5 g dry) from the same tree that yielded GSC-2373. Date is based on one 5-day count in the 5 L counter at 4 atmospheres, following purification with the KOH method (Lowdon et al., 1977; Lowdon, 1985).

GSC-2373-3 Bluefish Exposure, wood (III) >53 000

Wood (sample NMC-863; 45.3 g dry) from the same tree that yielded GSC-2373. Date is based on one 5-day count in the 5 L counter at 4 atmospheres. The objective was to reproduce the finite date of GSC-2373-2.

Comment (J.V. Matthews, Jr.): The bluff exposes an alluvial channel inset into an older alluvial sequence. The inset channel sequence fines upward to become a silt that is thought to be a near-shore facies of the glaciolacustrine clays seen at other exposures in the Bluefish and Old Crow Basins (Hughes, 1972; McCourt, 1982; Twelvemile Bluff series, GSC XIX, 1979, p. 30; CRH-15 series, GSC XXIV, 1984, p. 19-20; Matthews et al., 1987). The organic detritus dated by GSC-3946 comes from 4.3 m below the top of the section, in a unit of coarsely mottled grey to grey-brown silt which is near the base or slightly below the presumed lacustrine sediments. The log dated by the GSC-2373 series comes from approximately 9-10 m above the base of the inset channel and 8.02 m below the surface within a unit of sand and gravel.

The channel section has yielded pollen (McCourt, 1982), which implies, for the most part, xeric tundra. Although the sample dated by GSC-3946 was collected at a different time and by a different investigator than the pollen samples, it undoubtedly comes from the lower part of McCourt's Unit 11 and probably falls within his pollen zones BF 4a and/or BF 4b in which the pollen record is sporadic. Nevertheless, some levels from those zones have yielded spectra containing 5 percent **Picea** (spruce), >10 percent **Betula** (birch), traces of **Alnus** (alder) and in one case >20 percent Ericaceae pollen along with the usual high percentages of Cyperaceae (sedge), Gramineae (grass) and **Artemisia** (sage). The dated sample is located at or slightly above the level at which McCourt (1982) records a sudden rise in percentages of pre-Quaternary spores.

Plant macrofossils and insect fossils (identifications by J.V. Matthews, Jr.) are associated with the dated detritus. Among the insects are tundra species such as the beetles **Amara alpina** Payk., **Amara glacialis** Mann., a number of species of the subgenus **Cryobius, Helophorus splendidus** Sahlb., the pill beetle **Morychus** and an abundance of fragments of the weevil **Lepidophorus lineaticollis** Kirby. None of the insects refer to obligate forest species even though poorly preserved spruce and larch needles were seen among the plant macrofossils. The majority of plant macrofossils represent grasses, Crucifereae and Caryophyllaceae. A particularly interesting and unusual record, which supports the pollen evidence, is the presence of florets of **Artemisia**. The florets from the dated sample were not preserved well enough for identification, but in another sample located slightly lower in the section similar fossils refer to either or both **Artemisia frigida** Willd. and **Artemisia canadensis** Michx.

The wood dated by the the GSC-2373 series was located more than 1 m below the lowest of McCourt's pollen samples from the channel sequence. However, insect fossils from the organic horizon containing the tree trunk also suggest a dry tundra environment, or at least a dry and largely treeless floodplain. These fossils (identifications by J.V. Matthews, Jr.) include representatives of many beetle species that are typical of a sandy floodplain within an area of mesic to xeric tundra (e.g., **Nebria nivalis** Payk., **Elaphrus parviceps** VanD., several species of the subgenus **Cryobius, Pterostichus sublaevis** Sahlb., **Pterostichus haematopus** Dej., **Amara bokori** Csiki, **A. alpina** Payk., **Helophorus splendidus** Sahlb., **Simplocaria, Morychus, Lepidophorus lineaticollis** Kirby., and **Vitavitus thulius** Kiss.). One weevil species, **Connatichela artemisiae** Anderson, apparently feeds on **Artemisia** (Anderson, 1984).

Fossils of species that live exclusively in forested areas were not seen, even though the assemblage does include a few fragments of the carabid beetle **Harpalus amputatus** Say, a species sometimes found in dry grassland openings within the boreal forest. The organic detritus associated with the dated wood contained abundant "seeds" of grasses, sedges (mostly **Carex**), Cruciferae and Caryophyllaceae, as well as a few representing **Myriophyllum, Potamogeton, Hippuris, Papaver, Androsace, Sparganium, Linum, Salix,** and **Chenopodium** (identifications by J.V. Matthews, Jr.). Nutlets of shrub birch were seen as well as one or two spruce needles, but both are rare.

GSC-3946 is potentially a very significant date clarifying our understanding of regional events in the area. Because of this alone (but as well because the dated material was detritus) it should be confirmed by AMS dates on individual fossils. Until such time as this is done, the date is provisionally accepted as a true estimate of the age of the 39.2 m level because the detritus appeared to contain neither an abundance of potentially rebedded fragments nor any evidence of modern contaminants.

At the present time it is not exactly clear how the date of GSC-3946 relates to the sequence of meltwater and ponding events that characterized the region, but the date is consistent with other dates from the Bell and Old Crow basins which call for an early phase of meltwater ponding, shortly after 34 000 BP, followed by a period of fluctuating water levels centred around 25 500 BP, and then by a final Late Wisconsinan phase of high lake levels.

McCourt (1982) suggested on the basis of the infinite age of GSC-2373-3 that the sand and gravel from which the dated wood comes represents an interglacial. However, the macrofossils associated with the dated wood call for a climate colder than at present. The dated spruce tree probably grew in a restricted lowland grove within a region that possessed fewer forested tracts than is the case in the lowlands today.

Comment (W. Blake, Jr.): The sample used for GSC-2373, -2373-2, and -2373-3 is the entire cross-section of a log, 22.5 cm in diameter (total number of rings, 72 to 75; personal communication from J.V. Matthews, Jr., 1976). Little compression wood is present. The wet sample (8 rings, taken close to the outer surface) used for GSC-2373 was oven dried; the weight decreased from 31.2 to 11.8 cm. Approximately 30 annual rings were used for GSC-2373-2; on oven-drying the damp clean wood decreased in weight from 109 to 52 g. For GSC-2373-3 the damp wood (trace of mold noted when taken out of refrigerator) was also oven dried: 124 g (50 to 53 annual rings) decreased in weight to 52 g. Some outside wood was then cut off.

Sabine Point series

One peat and three wood samples were collected (frozen) from two coastal permafrost sections 26.2 km (peat) and 26 km (wood) west-northwest of Shingle Point, Yukon Territory (69°04'N, 137°48'W). Collected June 1, 1984 by D.G. Harry. Details of this section of the Yukon coast are presented in a manuscript entitled "The influence of ground ice upon Late Quaternary landscape evolution near Sabine Point, Yukon Coastal Plain", by D.G. Harry, H.M. French, and W.H. Pollard.

GSC-3986. Sabine Point (I) 11 000 ± 100

Peat (sample DGH-84-6; 50.0 g dry; organic detritus including twigs) from the base of approximately 2.0 m of lacustrine silt and sand, underlain by mudflow deposits and Buckland Till, at an elevation of 21.0 m. The section underlies an extensive thermokarst lake plain, and abuts a headland underlain by massive ice and ice-rich sediments which contained the other three samples in this series.

GSC-3993. Sabine Point (II) 8390 ± 120
$\delta^{13}C = -24.6‰$

A single piece of wood (sample DGH-84-7; 4.8 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 85-3 by R.J. Mott) from the base of 5.0 m of peat and organic silt, at an elevation of 29.5 m. The sampled layer overlies mudflow deposits which truncate a massive ice body.

GSC-3914. Sabine Point (III) 8980 ± 90
$\delta^{13}C = -26.5‰$

A single piece of wood (sample DGH-84-8; 10.9 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 84-31 by R.J. Mott) from the base of mudflow deposits, at an elevation of 27.0 m. The sampled layer overlies and thaw-truncates massive ice and ice-rich diamicton.

GSC-3922. Sabine Point (IV) >40 000

A single piece of wood (sample DGH-84-9; 11.9 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 84-31 by R.J. Mott) from stratified silty sand and sand, at an elevation of 2.0 m. The sampled unit is overlain by 10 m of stony clayey Buckland Till which includes, or is overlain by, ice-rich diamicton and massive ice.

Comment (D.G. Harry): GSC-3986 provides a maximum age for the initiation of lake sedimentation at this site. Organic material collected within an adjacent lake basin has yielded a date of 14 400 ± 180 (GSC-1792; GSC XVI, 1976, p. 12; Rampton, 1982). These dates suggest that the Yukon coastal plain was affected by major periods of thermokarst activity in Late Wisconsinan and early-Holocene times, during which significant landscape modification was achieved by thaw subsidence of ice-rich sediments of Buckland and/or post-Buckland age.

The thaw unconformity beneath mudflow deposits in the section containing the three wood samples probably marks the development of a small thermokarst basin or pond. Thus GSC-3914 provides a maximum age for the development of the thaw basin, and a minimum age for the underlying massive ice. The non-finite date for GSC-3922 does not permit the calculation of maximum ages for either the till or massive ice.

GSC-3993 provides a maximum age for the initiation of peat accumulation within the basin. Fossil insects and plant macrofossils associated with GSC-3993 were identified by J.V. Matthews, Jr. (unpublished GSC Fossil Arthropod Report No. 85-2 and unpublished GSC Plant Macrofossil Report No. 85-2). Coleoptera include **Pterostichus (Cryobius) arcticola** Chaud., **Pterostichus haematopus** Dej., **Acidota quadrata** (Zett.), and **Tachyporus** sp. Fossil Arachnida identified include Oribatei. These insects are expected to occur today in heath areas of the northern Yukon coast. All plant macrofossils within the sample are also representative of taxa that grow along the Yukon coast today. They are typical of areas of heath peatland where shrub birch is present and **Andromeda polifolia** and **Empetrum nigrum** are dominant.

Comment (W. Blake, Jr.): For the peat used for GSC-3986, after an examination for contaminants by J.V. Matthews, Jr., 148.0 g of wet sample was oven dried. Some twigs were included in the 50.0 g dry sample. Of several pieces of wood in GSC-3993, only the largest (12 cm long and 1.5 cm in diameter), with bark still attached, was used for dating. Likewise for GSC-3914, only the larger (40 cm long, 4 cm maximum diameter) of two pieces of wood was used. The bark was intact. On oven drying the weight decreased from 19.0 to 10.9 g. For GSC-3922 only the single largest piece of wood (29 x 5 x 3 cm) was used; one end was rounded, one was split. All outside wood and wood along cracks was cut off prior to air drying. GSC-3986 was based on one 5-day count in the 5 L counter, GSC-3993 was mixed with dead gas for counting and the date was based on one 3-day count in the 2 L counter, and both GSC-3914 and -3922 are based on one 3-day count in the 5 L counter.

King Point series

Two peat samples were collected (frozen) from a 2 m-thick unit exposed in a coastal permafrost section, located 31.5 km west-northwest of Shingle Point, Yukon Territory (69°05'N, 137°55'W). Collected June 4, 1984 by D.G. Harry.

GSC-3987. King Point (I) 7770 ± 90

Peat (sample DGH-84-13; 17.3 g dry) at an elevation of approximately 18 m. The dated material was directly underlain by a fossil ice wedge.

GSC-3982. King Point (II) 11 300 ± 90

Peat (sample DGH-84-15; 19.2 g dry) from the base of the unit, overlying sandy silt (interpreted as lacustrine sediments), at an elevation of approximately 17 m. Both sediment units are penetrated by large, epigenetic ice wedge systems.

Comment (D.G. Harry): GSC-3987 provides a maximum age for the thaw event which truncated the wedge (Harry et al., 1985). Fossil insects and plant macrofossils associated with GSC-3987 were identified by J.V. Matthews, Jr. (unpublished GSC Fossil Arthropod Report No. 85-3 and unpublished GSC Plant Macrofossil Report No. 85-3). Plant macrofossils are representative of an **Eriophorum** meadow environment, similar to those found in the coastal lowlands of the Yukon today. The assemblage of fossil arthropods, including Coleoptera, Diptera and Arachnida, found in the sample also substantiates this interpretation. The fossils contained within this sample are radically different from those found approximately one metre lower in the peat unit (see GSC-3982).

GSC-3982 provides a maximum age for the development of the ice wedges and for the initiation of peat accumulation at this site. The assemblages of both fossil arthropods and plant macrofossils (identified by J.V. Matthews, Jr.; unpublished GSC Fossil Arthropod Report No. 85-4 and unpublished GSC Plant Macrofossil Report No. 85-4) indicate the existence of a rather dry environment, or one that was scantily vegetated if located near water. Plant macrofossils are rare and rather poorly preserved. The presence of **Androsace septentrionalis** is of particular interest; this plant was apparently much more commonly distributed in Pleistocene Beringia and is not a fossil to be expected in an early Holocene assemblage from the northern Yukon.

Comment (W. Blake, Jr.): For both GSC-3982 and -3987 the sample submitted to the laboratory is the greater than 40 mesh (0.425 mm) size fraction, after picking and examination for contaminants. NaOH leach was omitted from the pretreatment of both samples. GSC-3987 showed no reaction with HCl, but -3982 gave a slight reaction. GSC-3987 is based on two 1-day counts in the 5 L counter. GSC-3982 is based on one 3-day count in the 5 L counter.

Northwest Territories

Hooper Island series

Wood and peat were collected from 4.5 m of pond deposits at the top of a 15.2 m-high sea cliff exposure on the north shore of Hooper Island, Northwest Territories (69°42'N, 134°55'W). Collected July 13, 1966 by J.G. Fyles. Comments are by V.N. Rampton, Terrain Analysis and Mapping Services, Ltd., Carp, Ontario.

GSC-1029. Hooper Island (I) 3700 ± 130
$\delta^{13}C = -26.8‰$

Twigs (sample FG-66-3e; 51.2 g wet, 10 g burnt; possibly **Salix** sp.; identified by J.G. Fyles) from close to the top of a 1.5 m-thick unit of silt and peaty silt containing freshwater gastropods. This unit is overlain by 1.2 m of peaty sand and peat, and is underlain by 1.5 m of sand containing plant material and 15 cm of organic silt and basal peat. Date is based on one 4-day count in the 5 L counter.

GSC-1056. Hooper Island (II) 11 800 ± 170

Organic silt (sample FG-66-3e; approximately 690 g damp, 40.5 g burnt) from a 15 cm-thick unit at the base of the sequence of pond deposits. NaOH leach was omitted from sample pretreatment. Date is based on two 1-day counts in the 2 L counter.

Comment (V.N. Rampton): GSC-1029 gives the approximate age of fossil pollen spectra found to have higher **Picea** frequencies than present pollen rain near the site and GSC-1056 dates fossil pollen spectra dominated by **Betula** pollen (Ritchie, 1972).

GSC-1031. Cabin Creek 9390 ± 150

Peat (sample FG-66-11c; approximately 910 g wet, 53 g burnt) from 0.3 m above the base of 4 to 5 m of lacustrine sediments exposed in a ruptured pingo near the head of Cabin Creek, Richards Island, Northwest Territories (69°18'N, 134°19'W). The lowest organic bed in the sequence is peaty; it rests on a fine grey sand with a 5 cm-thick layer of freshwater gastropod shells, and is underlain in turn by a clean, medium fine sand 45 cm or more in thickness which is the lowest unit exposed. Collected July 5, 1966 by J.G. Fyles.

Comment (V.N. Rampton): The date gives the approximate age for the rise of **Picea** in the pollen diagram derived from these sediments (Ritchie, 1972). NaOH leach was omitted from sample pretreatment. Date is based on two 1-day counts in the 5 L counter.

'Kate's Pond' series

Two series of pond sediment samples were extracted from a 406 cm long core taken in Kate's Pond (informal designation) in the Campbell-Sitidgi Lake area, Northwest Territories (68°22'N, 133°20'W), at an elevation of 125 m. Collected May 1982 by J.C. Ritchie, Scarborough College, University of Toronto, West Hill, Ontario, and R.W. Spear, then Scarborough College, now University of Minnesota, Minneapolis, Minnesota, using a modified Livingstone corer. The second series of samples was submitted for radiocarbon determination due to some confusion over the first series of dates.

GSC-3609. KP Series I, 120.5-125.5 cm 5960 ± 90
$\delta^{13}C = -29.8‰$

Firm gyttja (sample KP 5; 39.7 g dry) from 120.5 to 125.5 cm below the mud/water interface. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 6040 ± 90 BP.

GSC-3597. KP Series I, 177-183 cm 5420 ± 70
$\delta^{13}C = -26.7‰$

Firm gyttja (sample KP 4; 35.2 g) from 177 to 183 cm below the mud/water interface. Date is based on two 1-day counts in the 5 L counter. Uncorrected age: 5440 ± 70 BP.

GSC-3582. KP Series I, 217.5-222.5 cm 9000 ± 110
$\delta^{13}C = -27.1‰$

Firm gyttja (sample KP 3; 37.0 g) from 217.5 to 222.5 cm below the mud/water interface. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 9040 ± 110 BP.

GSC-3570. KP Series I, 283.5-288.5 cm 14 100 ± 340
$\delta^{13}C = -26.4‰$

Organic silt and clay (sample KP 2; 69.5 g dry) from 283.5 to 288.5 cm below the mud/water interface. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 14 100 ± 340 BP.

GSC-3554. KP Series I, 356.5-363.5 cm 8910 ± 100
$\delta^{13}C = -26.7‰$

Organic silt and clay (sample KP 1; 81.4 g dry) from 356.5 to 363.5 cm below the mud/water interface. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter. Uncorrected age: 8940 ± 100 BP.

GSC-3672. KP Series II, 115-120.5 cm 6660 ± 90
$\delta^{13}C = -28.4‰$

Firm gyttja (sample KP-E; 32.6 g dry) from 115 to 120.5 cm below the mud/water interface. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 6720 ± 90 BP.

GSC-3668. KP Series II, 183-189 cm 9130 ± 110
$\delta^{13}C = -25.3‰$

Firm gyttja (sample KP-D; 44.3 g dry) from 183 to 189 cm below the mud/water interface. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 9130 ± 110 BP.

GSC-3664. KP Series II, 212.5-217.5 cm 9630 ± 110
$\delta^{13}C = -26.1‰$

Firm gyttja (sample KP-C; 35.0 g dry) from 212.5 to 217.5 cm below the mud/water interface. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter. Uncorrected age: 9640 ± 110 BP.

GSC-3646. KP Series II, 278.5-283.5 cm 15 500 ± 440
$\delta^{13}C = -26.2‰$

Organic silt and clay (sample KP-B; 57.9 g dry) from 278.5 to 283.5 cm below the mud/water interface. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 2 L counter. Uncorrected age: 15 500 ± 440 BP.

GSC-3645. KP Series II, 350-356.5 cm 13 700 ± 190
$\delta^{13}C = -26.9‰$

Organic silt and clay (sample KP-A; 100.0 g dry) from 350 to 356.5 cm below the mud/water interface. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter. Uncorrected age: 13 800 ± 190 BP.

Comment (J.C. Ritchie): Preliminary analysis shows the pollen stratigraphy to conform with that of other sites in the area (Ritchie, 1984a). A complete analysis is in progress.

Comment (W. Blake, Jr.): A series of age determinations from a lake (M) in the Campbell-Dolomite hills is reported in GSC XXI (1981, p. 15; cf. also Ritchie, 1977). This series only goes back to 11 100 ± 90 BP (GSC-2075). NaOH leach was omitted from the pretreatment

of each sample from 'Kate's Pond'. The samples showed no reaction with HCl except as follows: GSC-3582, -3554, and -3645 showed a moderate reaction; GSC-3570, -3664, and -3646 showed a slight reaction.

'Sweet Little Lake' series

A series of sediment samples were extracted from a 396 cm-long core recovered from a small (6 ha) shallow (6 m) pond near the west side of Travaillant Lake, Northwest Territories (67°39'N, 132°01'W), at an elevation of 300 m. Collected April 1979 by L.E. Ovenden, then Scarborough College, University of Toronto, now GSC; L.C. Cwynar, then Scarborough College, now Sir Wilfrid Grenfell College, Memorial University of Newfoundland, Cornerbrook; and J.C. Ritchie, using a modified Livingstone piston corer.

GSC-3445. SW 3, 0-5 cm — 870 ± 120; $\delta^{13}C = -32.9‰$

Organic lake sediment (sample SW 3; 5.6 g dry) from 0 to 5 cm below the sediment/water interface. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 1000 ± 120 BP.

GSC-3443. SW 4, 123-127 cm — 3350 ± 100; $\delta^{13}C = -32.2‰$

Organic lake sediment (sample SW 4; 5.8 g dry) from 123 to 127 cm below the sediment/water interface. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter. Uncorrected age: 3470 ± 100 BP.

GSC-3439. SW 1, 239-245 cm — 5620 ± 80; $\delta^{13}C = -32.6‰$

Loosely compacted organic lake sediment (sample SW 1; 10.0 g dry) from 239 to 245 cm below the sediment/water interface. Date is based on two 1-day counts in the 2 L counter. Uncorrected age: 5740 ± 80 BP.

GSC-3436. SW 5, 305-310 cm — 8550 ± 80; $\delta^{13}C = -32.8‰$

Sticky clay with organic component and lake mud (sample SW 5; 36.8 g dry) from 305 to 310 cm below the sediment/water interface. Date is based on one 4-day count in the 2 L counter. Uncorrected age: 8680 ± 80 BP.

GSC-3430. SW 2, 344-351 cm — 9600 ± 100; $\delta^{13}C = -32.1‰$

Organic lake sediment (sample SW 2; 30.7 g dry) from 344 to 351 cm below the sediment/water interface. Date is based on one 4-day count in the 5 L counter. Uncorrected age: 9720 ± 100 BP.

GSC-3419. SW 6, 375-380 cm — 9520 ± 100; $\delta^{13}C = -27.1‰$

Fibrous organics in lake sediment (sample SW 6; 38.6 g dry) from 375 to 380 cm below the sediment/water interface. Date is based on two 1-day counts in the 5 L counter. Uncorrected age: 9550 ± 100 BP.

Comment (J.C. Ritchie): The published pollen data show (Ritchie, 1984b, p. 1385): "a **Betula-Populus-Juniperus** zone from 10 500 to 9000 years BP, a **Picea-Betula** zone from 9000 to 5100 years of poplar groves, juniper and **Shepherdia** shrub, and fragmentary patches of tundra, replaced rapidly by spruce woodland at roughly 8500 years BP, dominated initially by **Picea glauca. Picea mariana** spread extensively between 8500 and 5000 years BP, probably as a function of increasing paludification."

Comment (W. Blake, Jr.): NaOH leach was omitted from the pretreatment of each sample, and none of the samples showed any reaction with HCl.

Eskimo Lakes outwash series

Four samples of plant fragments and organic detritus in outwash sand collected from two sites along the shoreline of Eskimo Lakes, Northwest Territories. Collected 1971, 1972, and 1973 by V.N. Rampton, then GSC, now Terrain Analysis and Mapping Services Limited, Carp, Ontario.

GSC-1682. Eskimo Lakes Outwash (I) — 34 500 ± 690

Plant fragments and organic detritus (sample 288ROX2B; 15 g dry; the sample contained fragments of wood (mostly rounded, some much decomposed), roots, grasses(?), **Picea** sp. needles, **Potamogeton** sp. seeds, moss fragments (**Drepanocladus exannulatus, D. revolvens, Calliergon** sp., **Distichium** sp., **Hygrohypnum** sp.)), amber; unpublished GSC Bryological Report No. 151 by M. Kuc) from the base of an 8 m-thick unit of crossbedded, cross laminated and horizontally bedded sands, forming an outwash plain on the east side of an island in Eskimo Lakes (69°24.5'N, 131°59.5'W), at an elevation of 9 m. The sampled unit underlies 2 m of icy silt and overlies massive ground ice.

GSC-1995. Eskimo Lakes Outwash (II) — 13 000 ± 130

Plant fragments (sample 2ROZ; 6.7 g dry; Graminae; unpublished GSC Bryological Report No. 264 by M. Kuc) 9 m below surface of the outwash plain on the east side of the same island (69°24.5'N, 131°59.5'W), at an elevation of 6 m. The site is nearly identical to the location of GSC-1682. The dated material derived from a silty layer in crosslaminated sands, which form most of the upper 9 m of the scarps along the lake edge.

GSC-1784. Eskimo Lakes Outwash (III) — 14 100 ± 170

Fibrous organic material, mainly from a mat of grassy material (sample 320ROY-A; 56 g dry; grasses with attached roots and chlorophyll grains still identifiable in leaves noted in sample, also woody detritus, parts of **Potamogeton** sp., **Carex** sp., **Hippuris** sp., **Menyanthes trifoliata, Camptothecium nitens,** amber; unpublished GSC Bryological Report No. 202 by M. Kuc). Collected 5 m below the surface of the outwash plain on the south shore of Eskimo Lakes, Northwest Territories (69°04'N, 132°43'W), at an elevation of 13.5 m. The dated material is from the base of a large crossbed, 4.5 m from the top of crossbedded sand unit (at least 9 m thick), which is overlain by about 1 m of icy silt and locally underlain by massive ground ice.

GSC-1784-2. Eskimo Lakes Outwash (IV) — 12 900 ± 150; $\delta^{13}C = -26.1‰$

Grassy material separated from bulk organic material used for GSC-1784 (sample 320ROY-A; 9.0 g dry).

Comment (V.N. Rampton): The dates for GSC-1682 and GSC-1784 give incorrect ages for deposition of outwash as they contained re-worked amber, wood and plant fragments from eroded older strata. Dates for GSC-1995 (from equivalent strata at an adjacent site to GSC-1682), and GSC-1784-2 were obtained on grassy material from which older reworked material was removed. These two dates indicated that outwash was being deposited from an ice-front east of Sitidgi Lake (Fyles et al., 1972) at approximately 13 000 BP. For a detailed discussion of the glacial history of this area see the manuscript for GSC Memoir 423 entitled "Quaternary geology of the Tuktoyaktuk Coastlands, Northwest Territories", by V.N. Rampton.

Comment (W. Blake, Jr.): For GSC-1995 the sample was washed in distilled water to remove any adhering bits of 'old' organic debris such as pieces of rounded wood, bits of coal, amber, etc. The entire sample was picked over by hand to separate out the material used for dating, dominantly sedges and grasses. Washing also removed adhering silt. In the case of GSC-1784 the wet bulk sample was oven-dried overnight and the adhering silt was shaken out. For GSC-1784-2, the original bulk sample (another portion of the sample used for GSC-1784) was picked over to separate grasses and sedges from adhering sand and silt as well as from charcoal and other organic materials, such as amber. The sample was cleaned by washing and spraying on a sieve, then oven-dried. GSC-1784-2 differs only slightly from GSC-1784, so contamination in this case was much less severe than with GSC-1682. NaOH leach was omitted from the pretreatment of GSC-1682 only. All samples were treated with HCl and distilled water rinses. GSC-1784-2 and -1995 were mixed with dead gas for counting; each date is based on one 3-day count in the 2 L counter. GSC-1682 and -1784 are each based on one 3-day count in the 5 L counter.

Eskimo Lakes postglacial series

Wood samples in postglacial lacustrine sediments collected from exposures along the shoreline of Eskimo Lakes, Northwest Territories. Collected July 1971 and July 1973 (GSC-2023) by V.N. Rampton, then GSC, now Terrain Analysis and Mapping Services Ltd., Carp, Ontario.

GSC-1653. Eskimo Lakes Postglacial (I) 9130 ± 270

A single piece of wood (sample 316ROX-A; 2.7 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 71-72 by L.D. Wilson) from an exposure near the north end of a long narrow peninsula extending into Eskimo Lakes, Northwest Territories (69°13'N, 132°18'W), at an elevation of 3.5 m and 1.5 m below the top of the bench. The twig derived from woody detritus located at the mid-point of 1.8 m of horizontally-bedded sand and gravel, which overlies 1.8 m of clayey diamicton.

GSC-1685. Eskimo Lakes Postglacial (II) 4640 ± 140

Wood (sample 364ROX-B; 12.0 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 71-74 by L.D. Wilson) in coarse sand, from a bench located along the west shoreline of the bay north of Bonnieville Point, Northwest Territories (68°52'N, 133°28'W), at an elevation of approximately 2 m and about 3 m below the surface of the bench.

GSC-1710. Eskimo Lakes Postglacial (III) 10 700 ± 250

Fragile twigs with some bark (sample 318ROX-3A; 2.2 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 72-21 by L.D. Wilson) in sand 1.8 m below the top of an exposure near the northern tip of a point (the one nearest Urquart Lake) in Eskimo Lakes, Northwest Territories (69°07.5'N, 132°32.5'W), at an elevation of 13.6 m. At the point, the lower 6 m of the section is covered, but 8.2 m of crosslaminated, crossbedded and horizontally bedded sands overlie 1.2 m of massive brown sand. Bedding dips parallel to the slope of the land.

GSC-1936. Eskimo Lakes Postglacial (IV) 10 300 ± 120

A single piece of wood (sample 287ROX-3A; 7.0 g dry) from 3 m below the top of a bench near a point along the southern shore of Eskimo Lakes, Northwest Territories (69°25'N, 131°53'W), at an elevation of 3.6 m. The twig was taken from the mid-point of 3 m of interbedded sand and silt overlying 2 m of clayey diamicton and 1.6 m of sand.

GSC-2023. Eskimo Lakes Postglacial (V) 9180 ± 90

Wood (sample 1ROZ-A; 11.4 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 74-18 by L.D. Wilson), partially gnawed by beaver, at the base of a 2 m-thick peat unit on the north side of an island in Eskimo Lakes, Northwest Territories (69°25'N, 131°58.5'W), at an elevation of 3 m. Sand underlies the peat unit. In adjacent exposures 1.5 m of till and 6 m of sand overlie ground ice.

Comment (V.N. Rampton): The western part of the Eskimo Lakes are flanked by a pitted outwash plain, or one in which thermokarst depressions are well developed (Rampton and Walcott, 1974), and by an extensive lacustrine bench, which stands 6 to 8 m above sea level. Mackay (1963) has suggested that the latter bench and other higher benches were formed when drainage was blocked to the east and west by glacier ice. It would appear, however, that except for the 6 to 8 m bench most lacustrine benches and basins are related to thermokarst activity, which reached a maximum between 9000 and 10 000 BP (Rampton, 1973). The 6 to 8 m bench may have been created when the Eskimo Lakes initially formed through massive thermokarst activity at a time when their outlet to Liverpool Bay was blocked by a fluvial terrace dated at 10 900 ± 160 BP (GSC-1303; GSC XVIII, 1978, p. 12).

GSC-1710 was obtained from a sloping surface, which appears to have developed through thermokarst or fluvial activity on the pitted outwash plain that has been dated at approximately 13 000 BP (see GSC-1995 and -1784-2, this list). GSC-2023 was obtained from the base of a thermokarst basin in an outwash plain and the age is consistent with GSC-1469, -1469-2, and -1469-3 (9140 ± 170 BP, 9790 ± 180 BP, 9640 ± 350 BP, respectively; GSC XVI, 1976, p. 14-15) also obtained at the base of a thermokarst depression in the same outwash plain. GSC-1936 was obtained from a bench whose crest was about 6 m above sea level, and this dates the main postglacial lake bench that can be traced throughout the Eskimo Lakes area. GSC-1653 is related to either this postglacial lake or a separate thermokarst basin. GSC-1685 dates infilling of a shallow thermokarst basin established on the main postglacial bench.

Comment (W. Blake, Jr.): For GSC-1653, only the largest piece of wood, with some Fe-staining (12 cm long, 2 cm maximum diameter), was submitted for dating. It was dry on receipt, the ends did not exhibit much rounding, and some bark was still attached. All outside wood and wood along cracks was cut off. GSC-1685 was dry and well preserved (30 cm long, 10 cm maximum diameter), and all outside wood was cut off. For GSC-1710 the single largest piece (11.5 cm long, 1.5 cm maximum diameter) was used. It had no bark attached, but neither did the ends show significant rounding. Because of the small sample size the outside wood was not removed. the stick used for GSC-1936 (32 cm long, 1.5 cm maximum diameter) had little bark, was somewhat Fe-stained, and was rounded at one end; the outside was scraped clean. GSC-2023 was stored wet and there was some mold on the piece used (other pieces had more mold). All outside wood from this piece (27 cm long, 4 cm maximum diameter after oven drying) was cut off. GSC-1710 and -1936 were mixed with dead gas for counting. GSC-1653 was based on two 1-day counts in the 1 L counter; GSC-1685: one 3-day count in the 5 L counter; GSC-1710: two 1-day counts in the 2 L counter; GSC-1936: one 2-day count in the 2 L counter; and GSC-2023: two 1-day counts in the 5 L counter.

Eskimo Lake series

GSC-806. Eskimo Lakes (I) 6550 ± 140

Wood (sample FG-H-66-94B; 10.0 g burned; **Picea** sp. or **Larix** sp.) from 2.5 m below the top of a terrace in upper Eskimo Lakes, Northwest Territories (68°48'N, 133°23'W), at an elevation of 20.5 m. Stratigraphy of the exposure, in ascending order: 9 m yellow sand, 0.6 m grey till, 3 m grey sand, 9 m brown sandy gravel, 1 m brown sand, and 0.6 m peat. Collected August 29, 1966 by J.G. Fyles and G.M. Haselton, Clemson University, Clemson, South Carolina.

GSC-671. Eskimo Lakes (II) 8000 ± 160

Twigs (sample FG-66-165a; 9.1 g burned) from sands, 4.5 m below the top of a 5.5 m bench of cross-bedded gravel and sand in upper Eskimo Lakes, Northwest Territories (68°56'N, 133°22'W), at an elevation of 1 m. Collected August 30, 1966 by J.G. Fyles.

GSC-491. Eskimo Lakes (III) >39 600

Wood (sample F6-65-35a; 9.0 g burned; probably **Picea** sp. or **Larix** sp.) from 6 m above lake level in an exposure in upper Eskimo Lakes, Northwest Territories (68°51'N, 133°11'W), at an elevation of 6 m. Stratigraphy of the exposure, in ascending order: 24 m brown sand containing wood mats, 1 m of lag gravel, and 6 m greyish-brown sand. Collected 1965 by J.G. Fyles.

Comment (V.N. Rampton): GSC-491 indicates that the brown sands predate the late Wisconsin, but it does not clarify their position relative to nearby peat, which has been dated at >50 900 BP (GSC-329; GSC V, 1966, p. 117). GSC-671 is possibly related to thermokarst or to a former 8 m lake level (cf. Mackay, 1963); the date is consistent with a date of 7400 ± 200 BP (GSC-16; GSC I, 1962, p. 21) obtained on peat overlying lake sediments, 1 m above present lake level. GSC-806 is from a deposit that, on the basis of geomorphic evidence, appears to be older than the deposits that GSC-16 and GSC-671 date. It may be that the upper gravels at GSC-806 were deposited in a thermokarst lake, which has since been drained. GSC-491 is based on one 3-day count in the 5 L counter, GSC-671 is based on two 1-day counts in the 2 L counter, and GSC-806 is based on two 1-day counts in the 5 L counter.

Little Chicago series

One sample from each of two lakes in the Little Chicago region, Northwest Territories; Windy Lake (informal designation) 67°12'N, 130°46'W, 300 m a.s.l. and 'Y' Lake (informal designation) 67°15'N, 130°45'W, 210 m a.s.l. Collected May 1979 by J.C. Ritchie, L.C. Cwynar and L.E. Ovenden using a modified Livingstone corer.

GSC-3454. Windy Lake, 118-122 cm 6280 ± 70
$\delta^{13}C = -26.9‰$

Organic mud and clay (sample LCW1; 61.3 g dry) from 118 to 122 cm below the mud/water interface in a lake in a moraine. Uncorrected age: 6310 ± 70 BP.

GSC-3458. Y Lake, 317-323 cm 8680 ± 90
$\delta^{13}C = -26.9‰$

Organic silt and clay (sample LCY 1; 42.3 g dry), including some wood and moss fragments, from 317 to 323 cm below the mud/water interface in a lake in a moraine. Uncorrected age: 8710 ± 90 BP.

Comment (J.C. Ritchie): In each case, the date corresponds to the **Alnus** rise. However, there are various problems with the pollen stratigraphy. Further analysis was not attempted. NaOH leach was omitted from the pretreatment of both samples. Neither sample showed any reaction with HCl. Each date is based on two 1-day counts in the 5 L counter.

GSC-2035. Grotte Valerie 110 ± 60
$\delta^{13}C = -26.7‰$

Packrat feces (sample C2, 20.0 g dry; **Neotoma cinerea;** identified by N.M. Simmons) from a cave, Grotte Valerie, in the south wall of First Canyon (near its mouth), South Nahanni River, 48 km northwest of Nahanni Butte, Northwest Territories (61°17'N, 124°05'W), at an elevation of 760 m and 455 m above the river. Collected July 4, 1972 by N.M. Simmons, then Canadian Wildlife Service, Fort Smith, N.W.T.

Comment (W. Blake, Jr.): Other dates on wood and a Dall's sheep skull from Grotte Valerie are considerably older (cf. GSC XIII, 1973, p. 36; GSC XIX, 1979, p. 35; Scotter and Simmons, 1976). The submitter scooped the feces out of the nest by hand, and the sample was stored in a clean plastic bag. In the laboratory the feces were carefully picked out by hand so as to exclude separate pieces of **Juniperus,** etc. The sample also contained cone scale fragments of **Picea** sp., leaves and berries of **Juniperus communis,** a leaf fragment of **Betula** sp., a leaf and a seed of **Arctostaphylos uva-ursi,** and a seed of **Rubus** sp. (unpublished GSC Plant Macrofossil Report No. 74-4 by M. Kuc). All feces were 1 to 2 cm long and less than 0.5 cm in diameter. The sample was treated with NaOH, HCl, and distilled water rinses. Date is based on one 1-day count in the 5 L counter.

GSC-3941. Cox Lake, southwest 9430 ± 110
$\delta^{13}C = +1.4‰$

Marine pelecypod shell fragments (sample SV-84K-42A; 27.0 g; **Mya truncata,** identified by W. Blake, Jr.) from a sandy clay subtidal deposit in a riverbank exposure, 10 km southwest of Cox Lake, Northwest Territories (67°48'N, 116°40'W), at an elevation of approximately 73 m. The sampled unit overlies 7 m of massive marine clay which is in turn underlain by a 33 m-thick fining upward sequence consisting of basal subaqueous outwash gravel and upper glaciolacustrine silty-clay rhythmites. Collected August 1984 by D.E. Kerr, then University of Ottawa, Ottawa, now University of Alberta, Edmonton; submitted by D.A. St-Onge.

Comment (D.E. Kerr): This date, as well as GSC-3663 (10 300 ± 240 BP; GSC XXIII, 1983a, p. 25), suggests that marine silts and clays had been accumulating in the basin of the Richardson and Rae rivers since at least 10 500 BP. Assuming that the date for GSC-3663 is associated with a water plane 60 m below the marine limit (150 m a.s.l.), the initial marine incursion may have taken place as early as 11 400 BP.

Comment (W. Blake, Jr.): The sample submitted to the laboratory was one whole left valve plus one left valve fragment and five right valve fragments; all included the truncated end typical of the species. The largest valve used measured 4.7 by 3.5 cm. All shells except the smallest were greater than 2 mm in thickness, and they were characterized by the lack of both lustre and periostracum. Date is based on two 1-day counts in the 2 L counter.

GSC-4009. Cox Lake, southeast 6100 ± 80
$\delta^{13}C = -27.9‰$

A single piece of wood (sample SV-84K-12C; 11.4 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 84-48 by R.J. Mott) from a sandy silt layer in a fresh riverbank exposure, 15 km southeast of Cox Lake, Northwest Territories (67°48'N, 116°11'W), at an elevation of approximately 25 m. Collected August 1984 by D.E. Kerr, submitted by D.A. St-Onge.

Comment (D.E. Kerr): The wood is contained in sandy upper tidal flat sediments which represent the upper member of a general coarsening upward sequence associated with the postglacial marine regression in the Richardson and Rae River basins.

Comment (W. Blake, Jr.): The well preserved and clean piece of wood used was 24.5 cm long and had a maximum diameter of 2 cm. It was characterized by rough ends and a smooth outer surface; the outermost wood was scraped off. Date is based on two 1-day counts in the 5 L counter.

GSC-2671. Western River 3490 ± 70

Wood (sample CIA-77000-1; 11.1 g; **Salix** sp.; unpublished GSC Wood Identification Report No. 77-29 by L.D. Farley-Gill) from a bluff along Western River, 75 km south-southeast of Bathurst Inlet, northeastern District of Mackenzie, Northwest Territories (66°17.8'N, 107°5.9'W), at an elevation of 23 m. The sample was collected from the base of a fresh exposure of delta foreset beds (mainly sand) 13 m below the top of the bluff. The foreset beds are about 13 m thick and are directly underlain by about 14 m of subhorizontal bottomset beds. Collected July 27, 1977 by J.J. Clague.

Comment (J.J. Clague): It was hoped that GSC-2671, together with comparison sample GSC-3270 (3860 ± 60; GSC XIV, 1984, p. 23) at 33 m, would provide data on the rate of delta aggradation at this point. Because the lower sample (GSC-2671) is younger than the sample collected 10 m higher in the section, the most logical conclusion is that the upper piece of wood was reworked, and that when GSC-2671 was deposited, approximately 3500 BP, sea level relative to the land was at least 23 m, and possibly more than 36 m, higher than at present.

Northern Canada, Arctic Archipelago

Banks Island

GSC-222-2. Nelson Head 47 000 ± 1000
$\delta^{13}C = -26.9‰$

Wood (sample FG-60-42a; 41.0 g; **Salix** sp.; unpublished GSC Wood Identification Report No. 73-51 by L.D. Wilson) from the eroded face of a major moraine 4.8 km north-northeast of Nelson Head, Banks Island, Northwest Territories (76°08.5'N, 122°42'W), at an elevation of 12 m (altimeter determination). The wood was found in a grit-sand-silt-pebble gravel unit which was overlain by 3 m of barren silt at the base of a 60 m-high shore bluff consisting mainly of till and dirty (glacio-fluvial) gravel, sand and silt. The till is a landward remnant of a moraine built from the Amundsen Gulf (seaward side). Collected June 20, 1960 by J.G. Fyles; submitted 1973 by W. Blake, Jr.

Comment (W. Blake, Jr.): This age determination is a re-run on another portion of the sample used for GSC-222, >41 600 (GSC IV, 1965, p. 39). As I stated in an earlier report (Blake, 1974a, p. 1038), "It should be stressed that this sample shows only slight activity, and its counting rate is so close to the counting rate of the background that a very small variation in either could result in computation of a 'greater than' age. The three individual 3-day counts did, however, each allow finite ages to be calculated as follows: 47 400 ± 900, 48 300 ± 1000, and 45 600 ± 800. More collecting and dating are needed from this site". In view of the above comment it seems safest to treat GSC-222-2 as a minimum age.

Two pieces of dry wood, both slightly flattened and oblong were submitted to the laboratory; they were 14 and 13 cm long, and had maximum diameters of 3.5 and 5.0 cm, respectively. All outside wood and wood along cracks was removed. Pretreatment included a 1 hour leach in hot NaOH, a 1 hour leach in hot HCl, and distilled water rinses. Date is based on three 3-day counts in the 5 L counter at 4 atmospheres.

Banks Island BK series

Lacustrine muds were recovered by Livingstone piston corer from a lake in a meltwater channel 14.5 km north of Nelson Head, southern Banks Island, Northwest Territories (71°21'N, 122°30'W), at an elevation of 280 m (according to the 1:50 000 contour map, 97 H/6). The lake is approximately 2 km long and 0.6 km wide, and at the coring site (near the centre of the lake), the water depth was 9 m. Collected May 1975 by K. Hadden, M. Mantuani, and J.C. Ritchie, all of Scarborough College, West Hill, Ontario.

GSC-3827. BK4, 76-86 cm 14 600 ± 190
$\delta^{13}C = -25.4‰$

Lake mud (sample BK 4; 151.4 g dry) from 76 to 86 cm below the sediment/water interface. Date is based on one 3-day count in the 2 L counter.

GSC-3819. BK3, 105-115 cm 34 100 ± 1060
$\delta^{13}C = -21.5‰$

Lake mud (sample BK 3; 193.8 g dry) from 105 to 115 cm below the sediment/water interface. Date is based on one 3-day count in the 2 L counter.

GSC-2780. BK1, 148-153 cm 26 900 ± 1560
$\delta^{13}C = -19.6‰$

Lake mud (sample BK 1; 149.5 g dry) from 148 to 153 cm below the sediment/water interface. Date is based on two 1-day counts in the 2 L counter.

Comment (J.C. Ritchie): The pollen record from this site yielded low concentrations in all samples, and a high proportion of exotic (mainland) taxa (**Picea, Alnus, Pinus, Betula** p.p.). One interpretation, that conforms with the geological history (Vincent, 1983, 1984), and which is supported also by the radiocarbon dates (disregarding the inversion), would be that the section spans the approximately last 25 000 years, including a lower **Picea** maximum (interstadial), a mid-section NAP (full glacial maximum), and the usual postglacial sequence of **Betula-Picea-Alnus.** On the other hand, the radiocarbon dates have been questioned as being too old (W. Blake, Jr., personal communication, 1979).

Comment (J-S. Vincent): The cored lake is within a meltwater channel deeply incised (>100 m, as measured on the 1:50 000 topographic map) into Early Wisconsinan Jesse Till laid down during M'Clure Stade of Amundsen Glaciation and into older sediments, mostly the Lower Cretaceous Christopher Formation (Vincent, 1983). Assuming the old ages obtained on the core increments are not the product of contamination by old carbon, and that the palynostratigraphy indeed documents climatic change from an interstadial (Middle Wisconsinan), through a full glacial stade to the present, then the age determinations reinforce the hypothesis that southern Banks Island was not covered by Laurentide ice in the Late Wisconsinan (Vincent, 1984).

Comment (W. Blake, Jr.): Obviously great care must be exercised if these age determinations are to be used, in part because several formations on Banks Island contain shale, lignite, wood, etc., all sources of pre-late Pleistocene carbon (Miall, 1979). The history of this area is most interesting, and additional coring in one or more carefully selected lakes in the vicinity is warranted in order to try to resolve the problem. At the time of writing equivalent age materials have not been recovered from sections or from coastal exposures on Banks Island. Materials dated are either more

than 40 000 years old, or younger than 11 000. The oldest finite dates of latest Pleistocene age are 10 660 ± 170 BP (GSC-240; GSC IV, 1965, p. 38-39) on plant debris from the Masik River valley, 10 200 ± 130 BP (GSC-2673; GSC XX, 1980, p. 19-20) on moss remains from 275 to 280 cm depth in a core from a small lake in the Thomsen River valley (Shoran Lake), and 10 600 ± 130 (GSC-3229; GSC XXIII, 1983a, p. 27) on wood from a coastal section at Thesiger Bay. NaOH leach omitted from the pretreatment of all three samples. Both GSC-3819 and -3827 showed slight reaction with HCl. All three samples were mixed with dead gas for counting.

Duck Hawk Bluffs series, Section J

Section J, a coastal bluff, exposes 0.6 m of fine marine sands overlain by a 0.5 m-thick compressed and deformed autochthonous woody peat layer, 0.5 m of poorly sorted sands and fine gravel, 1.75 m of fossiliferous glaciomarine silty clay, and 3 m of till. The section is situated 1.3 km east of the mouth of Mary Sachs River and 9 km west of Sachs Harbour on Thesiger Bay, Banks Island, Northwest Territories (71°58.3'N, 125°30.2'W), at an elevation of approximately 2 m. Two age determinations were made on the woody peat, collected on July 17 and 21, 1983 by J-S. Vincent and S. Occhietti, Université de Québec à Montréal, Montréal. One determination was made on shells, collected from the glaciomarine unit on July 17 and 21, 1983 by J-S. Vincent.

GSC-3560. Duck Hawk Bluffs, Section J (I) >36 000

Woody peat (sample VH-81-005B; 40.0 g dry) extracted from the organic bed described above. The woody peat was collected wet in the field and was subsequently oven dried. In drying, it decreased in weight from 340 to 136.5 grams. The noncalcareous sample was treated with hot base, hot acid, and distilled water rinses to neutral pH. Date is based on one 4-day count in the 5 L counter.

GSC-3560-2. Duck Hawk Bluffs, Section J (II) >49 000

Woody peat (sample VH-81-005B; 96.5 g dry) extracted from the organic layer described above. The noncalcareous sample was treated with hot NaOH, hot HCl, and distilled water rinses to neutral pH. Date is based on a two 1-day counts and one 3-day count in the 5 L counter at 4 atmospheres.

GSC-3698. Duck Hawk Bluffs, Section J (III) >37 000 $\delta^{13}C = +0.2‰$

Marine shells (sample VH-83-011; 52.0 g; **Portlandia arctica**; identified by A. Aitken, McMaster University, Hamilton, Ontario) 2.5 m a.s.l., from the glaciomarine silty clay above the woody peat bed. Because of the sample size, only the outer 10% of shell material was removed by HCl leach. Date is based on one 3-day count in the 5 L counter.

Comment (J-S. Vincent): Section J of the Duck Hawk Bluff series is described in Vincent et al. (1983). The fine marine sands, with a rich foraminifera population and underlying the organic layer, are believed to have been laid down in the Big Sea, a marine transgression which flooded extensive areas of western Banks Island during the Middle Pleistocene Thomsen Glaciation. The fossiliferous glaciomarine sediments and Sachs Till overlying the organic bed are assigned to the M'Clure Stade of the Amundsen Glaciation believed to be of Early Wisconsinan age (Vincent, 1984).

On the basis of its stratigraphic position between presumed Middle Pleistocene marine beds and Early Wisconsinan glacial deposits, the dated organic layer is believed to date from the Cape Collinson Interglaciation (Sangamonian) of the Banks Island Quaternary framework. The wood in the organic deposit was identified as **Salix** sp. (unpublished GSC Wood Identification Report No. 82-2 by R.J. Mott), whereas the peaty deposits were made up of stem fragments and other filamentous plant debris likely of mosses (unpublished GSC Plant Macrofossil Report No. 81-35 by J.V. Matthews, Jr.). Macrofossil remains of poorly preserved **Carex** sp. as well as seeds of **Ranunculus lapponicus** L., and **Hippuris** sp., both absent on Banks Island today, were also identified. The sample was dominated by sedge pollen, most of it probably of local origin, but it contained some **Picea, Alnus, Salix** and grass (Matthews et al., 1986). The ground-beetle **Diacheila polita** Fald., which does not live on Banks Island today, was also identified in the sample (Matthews et al., 1986). The aspartic acid D/L ratio for pieces of **Salix** wood was 0.12 (UA-1094; Vincent et al., 1983). The <49 000 age determination confirms the antiquity of the organic bed and, although we assume a Sangamonian (Stage 5) age for the sample, it could be argued that it may be older or even younger (Early Stage 3).

The marine shells in the glaciomarine unit were collected in situ and were extremely well preserved. Paired valves of **Portlandia arctica portlandia**, with their periostracum still attached, and **Buccinum tottenti, Bathyarca glacialis, Colus pubescens, Colus togatus** and **Natica clausa** (all identified by A. Aitken, McMaster University, Hamilton, Ontario) made up the collection. Total alle/Ile determinations on three valves of **Portlandia** sp. provided ratios of 0.023, 0.025, and 0.027 (AAL-385 A,B,C). These ratios are consistent with a Wisconsinan age (G.H. Miller, personal communication, 1984). A U/Th age determination, also on **Portlandia** sp. valves, gave a result of 92 400 $\pm \frac{7000}{6400}$ BP (UQT-143) corrected to 87 ka BP (Causse and Hillaire-Marcel, 1986). The glaciomarine deposit contains inclusions of the overlying Sachs Till (Vincent et al., 1983; Vincent, 1984) deposited by the Thesiger Lobe during the M'Clure Stade of Amundsen Glaciation (Vincent, 1982, 1983). The fact that the limit of extent of Sachs Till is situated only a few hundred metres inland from Section J, and that the glaciomarine sediments were laid down immediately prior to the deposition of Sachs Till indicates that the shells, give an age estimate of the time at which Thesiger Lobe ice impinged on the southwestern coast of Banks Island. The ^{14}C age of <37 000, the indications from the amino acid and uranium thorium analyses, and the fact that the shell bearing deposits are intimately linked with the advance of the Thesiger Lobe, clearly indicate that the M'Clure Stade is pre-Late Wisconsinan and likely pre-Middle Wisconsinan in age. On the basis of the "warm" character of the organic deposits which underlie M'Clure Stade tills, both in section J of the Duck Hawk Bluffs and at the type section of Cape Collinson Formation beds (= Sangamonian) east of the mouth of the Nelson River, an early Wisconsinan age for the M'Clure Stade is proposed (Vincent, 1982, 1983, 1984).

GSC-3585. Duck Hawk Bluffs, Section H >39 000

Compressed moss peat with twigs in eolian and/or tundra pond silts (sample VH-81-12A; 21.0 g dry) from coastal section H in the Duck Hawk Bluffs, situated 5.5 km west of the mouth of Mary Sachs River and 16 km west of Sachs Harbour on Thesiger Bay, Banks Island, Northwest Territories (71°52.7'N; 125°41'W), at an elevation of approximately 35 m. Collected July 28, 1981 by J-S. Vincent and S. Occhietti, Université de Québec à Montréal.

Comment (J-S. Vincent): Section H of the Duck Hawk Bluff series is discussed in Vincent et al. (1983). Thirty metres of Beaufort Formation sands and gravels are overlain by: (1) 2 m of stratified silts and 3.5 m of yellowish sands (Worth Point Formation), (2) a thin bed of Cretaceous Kanguk

Formation silts with tephra bands thrust by or carried at the base of the Banks Glacier, (3) 4 to 5 m of Bernard Till (Duck Hawk Bluffs Formation) laid down during the Early Pleistocene Banks Glaciation, (4) 0.5 m of oxidized sands and gravels possibly deposited in the Post-Banks Sea, (5) 2 m of eolian and/or pond silts with a 5 cm-thick lower peat bed (sample VH-81-12A) and a 50 cm-thick upper peat bed (Morgan Bluffs Formation), and (6) 1.5 m of slope deposits. According to unpublished GSC Plant Macrofossil Report No. 81-25 by J.V. Matthews, Jr., the dated sample was mainly composed of both well and poorly preserved diverse mosses which were laid down in a poorly drained low Arctic tundra environment. Seeds of **Betula glandulosa** type, **Carex** sp. **Carex aquatilis** Wahlenb, **Potentilla palustris** (L.) Scop., **Rubus chamaemorus** typ., **Hippuris vulgaris** L., **Empetrum nigrum** L., and **Arctostaphylos** sp. were identified as well as capsules of **Salix** sp. and leaves of **Dryas integrifolia** M. Vahl. Twigs in the mossy peat, some with bark and some round, often charred, were identified as **Salix** sp. (unpublished GSC Wood Identification Report No. 82-2 by R.J. Mott). Also present in the sample were elytra of the ground beetle **Pterostichus (Cryobius)** sp. and fragments of the predaceous diving beetle **Colymbetes** sp. ephippia of the water flea **Daphnia** sp., abundant **Lepiduris** sp. mandibles, and a few small mammal feces (unpublished GSC Fossil Arthropod Report No. 81-19 by J.V. Matthews, Jr.). According to Matthews, the animal remains indicate that the organics are nearly autochthonous and were likely laid down in, or in the proximity of, small temporary ponds. Concurrent eolian activity to produce the silt is also likely. Sedge pollen dominated in the sample, with **Betula, Picea, Pinus, Salix, Alnus, Artemisia**, Tubuliflorae, Gramineae, Rosaceae, and Ranunculacae also present. Spores of **Sphagnum**, and **Pediastrum** were common (Matthews et al., 1986). The aspartic acid D/L ratios for pieces of the **Salix** wood range from 0.12 to 0.13 (UA-1001 and -1103, Vincent et al., 1983). A U/Th age determination on the wood gave a nonfinite result (>200 ka BP; UQT-229; Causse and Hillaire-Marcel, 1986). The assignment of the dated organic bed to one of the recognized lithostratigraphic units in the Duck Hawk Bluffs was initially difficult because the enclosing sediments lay directly above Bernard Till, which is known to date from the Early Pleistocene because its sediments are magnetically reversed (Vincent et al., 1984), and below slope deposits of likely Holocene age. Thus the peat could have dated from any period between the Middle Pleistocene and the Holocene. Because the peat beds are autochthonous, the radiocarbon age determination indicates that the unit definitely predates the Late Wisconsinan. Initially the unit had been tentatively assigned (Vincent et al., 1983, p. 1708) to the Cape Collinson Formation (Sangamonian Interglaciation). On the basis of the recent U/Th determination results, it is likely that the unit is of Middle Pleistocene age (>128 ka-<730 ka). Consequently the deposits are assigned to one of the warm intervals during the long Morgan Bluffs Interglaciation. The existence of a climate warmer than the present day interglaciation is documented by the presence of **Betula glandulosa** "seeds".

Comment (W. Blake, Jr.): The sample was air dried for several weeks; the weight of one bag of material was 527.0 g. The sample was then wet sieved through a 40 mesh screen, and all twigs were removed by hand. After oven drying the moss portion weighed 69.7 g. The noncalcareous sample was treated with hot NaOH, hot HCl, and distilled water rinses to neutral pH. The age estimate is based on one 3-day count in the 5 L counter.

GSC-4071. Sachs Harbour 6520 ± 90

Sedge peat (sample HMF-1978-08-13 no. 1; 29.0 g dry) from the base of a 4 m-thick accumulation of peat in a gully, 4.1 km east of Sachs Harbour, Banks Island, Northwest Territories (71°58.9'N and 125°07.2'W), at an elevation of approximately 2.5 m. Collected August 13, 1978 by H.M. French, University of Ottawa, Ottawa, Ontario.

Comment (H.M. French and J-S. Vincent): The well preserved peat deposit rests on a 10 to 20 cm-thick gravel and coarse sand unit and about 2 m of fine stratified sand which are part of a fluvial terrace along the Sachs River. The peat is capped by 0.5 m of eolian sand and colluvium. The gully in which the peat accumulated is incised in old terrace sediments capped by the older of two series of well developed and conspicuous solifluction sheets at the base of the Sachs Harbour scarp. The age determination, therefore, provides a minimum age for the development of the older series of solifluction sheets. Since the peat accumulations are also progressively being covered by a younger series of solifluction sheets from upslope, the age determination provides a maximum age for this younger solifluction episode.

Comment (W. Blake, Jr.): The basal 5 cm of this well preserved peat, including material around and above cobbles, was cut out and used for dating. The sample was treated with hot NaOH, hot HCl (slight reaction), and distilled water rinses to neutral pH. Date is based on two 1-day counts in the 5 L counter.

Dissection River series

Wood and peat from a 15 to 16 m-high exposure along the south bank of Dissection River, a tributary leading to Thomsen River, Banks Island, Northwest Territories (73°16.4'N, 119°32'W). The site is below the 200 ft. contour (60 m) on the 1:250 000 map sheet (88C, Parker River). Samples -221 and -226 collected August 14, 1975 by W. Blake, Jr. Sample -224 collected the same day by W. Blake, Jr. and J-S. Vincent.

GSC-2284. Dissection River (I) 8530 ± 110

Wood (sample BS-75-221; 3.1 g; **Salix** sp.; unpublished GSC Wood Identification Report No. 76-6 by L.D. Farley-Gill) extracted from the uppermost of three peat layers. This peat overlay a gravel-rich sand. Above the frozen, dark gray-brown peat was a brownish peat (probably part of the same peat unit but lighter in colour because it was dry at the time of collection), colluviated till (the site lies within the area of Baker Till, assigned by Vincent (1983) to the Thomsen Glaciation), and surface vegetation.

Comment (W. Blake, Jr.): The peat accumulated at a time when the river channel was not in its present position (cf. Miles, 1976). Some of the wood stuck out from the frozen face, other pieces were hacked out; most derived from larger twigs and stems, but they were broken during collection. The wood and enclosing peat were stored wet until they reached Ottawa, at which time they were refrozen until the wood was prepared for dating. Twenty-five pieces of wood, all less than 7 cm in length, and ranging from 3 to 8 mm in diameter, were used for dating. On oven drying the sample decreased in weight from 10.2 to 3.1 g. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2819. Dissection River (II) >39 000

Peat (sample BS-75-224; 49.0 g dry) from the middle of three organic layers, slightly more than halfway up from river level to terrace top. This organic layer is overlain by bedded gravels.

Comment (W. Blake, Jr.): The result indicates only that at some point in time, beyond the range of radiocarbon dating, an episode of peat formation followed an interval during which the precursor of 'Dissection River' occupied the site. The change was presumably the result of a shift in the

course of the river and perhaps in climatic conditions. A 328 g subsample of wet peat was dried in an electric oven; dry weight, 99.6 g. Date is based on one 5-day count in the 5 L counter.

GSC-2375. Dissection River (III) >43 000

Wood (sample BS-75-226; 5.7 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 76-25 by R.J. Mott) extracted from the bottom part of the lowermost of the three peat layers, approximately 4 m above river level. The peat layer is 5 to 10 cm in thickness, and it is overlain by a varying thickness of a mixed unit, containing silt, sand and clay.

Comment (W. Blake, Jr.): On the basis of this determination, another portion of the same sample was run at 'high-pressure' (GSC-2375-2, this series). The wet wood, upon oven drying, decreased in weight from 23.0 to 8.3 g. Six pieces were used for dating. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 2 L counter.

GSC-2375-2. Dissection River (IV) 49 100 ± 980

Peat (sample BS-75-226; 103.0 g dry) comprising the 5 to 10 cm-thick unit from which the wood used for GSC-2375 was extracted.

Comment (W. Blake, Jr.): With regard to the age determinations on the two lower peat units Vincent (1982, p. 227-228) stated, "The peats are likely associated with fluvial sediments laid down when sea level was higher than today. Since the Investigator Sea is the last sea to have drowned the Thomsen River basin in pre-Late Wisconsinan time, the determination may provide a minimum age for the retreat of the Prince Alfred Lobe and the drainage of Lake Ivitaruk which preceded the sea in question." (See also Vincent, 1978, 1980, 1983, 1984; Matthews et al., 1986). Details of the plant macrofossils and fossil arthropods are summarized in Table 3, DR assemblage (Matthews et al., 1986).

For this 'high pressure' determination (GSC-2375-2) 320 g of frozen peat was dried in an electric oven; the weight decreased to 245.5 g. Following the usual pretreatment for 'high pressure' samples the sample was purified using the KOH method (Lowdon et al., 1977). Date is based on one 5-day count in the 5 L counter at 4 atmospheres.

Melville Island

GSC-1760-2. Cape James Ross (?) 21 600 ± 230
$\delta^{13}C = -21.1‰$

Tusk fragment of an elephant (sample NMC-11833; 702 g; Proboscidea cf. **Mammuthus**; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa) perhaps collected near Cape James Ross, Dundas Peninsula, Melville Island, Northwest Territories (coordinates of Cape James Ross: 75°42'N, 114°25'W). The possibility cannot be excluded, however, that the collection site was actually on Banks Island (cf. Kindle, 1924, in which "Banks Island", about latitude 72° is cited). Collected 1916 by members of the Northern Party of the Canadian Arctic Expedition (leader V. Stefansson). Two determinations were made:

GSC-1760. First determination 21 900 ± 320
$\delta^{13}C = -20.5‰$

A 702 g sample was first treated with 3N HCl, but no reaction occurred. The sample was then given the bone apatite treatment (repeated leaches with acetic acid in an aspirator, which caused effervescence), and the residue was neutralized with repeated distilled water rinses. Half of the residue was treated with H_3PO_4 in the shell apparatus, but the yield of CO_2 was insufficient. The remainder was dried and the solution became gelatinous. The top part (gelatin only) was re-dried and 12.5 g was heated in a stream of nitrogen, then oxygen was utilized while heating continued. Ignition did not occur and a residue of 6.5 g remained as ash. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-1760-2. Second determination 21 600 ± 230
$\delta^{13}C = -21.1‰$

For this determination part (45.5 g) of the original treated and dried sample (gelatinous) was burned and the CO_2 was purified using the KOH method (Lowdon et al., 1977). Date is based on two 1-day counts in the 5 L counter.

Comment (C.R. Harington): This tusk fragment, probably representing a mammoth, is the most northerly record for a Quaternary elephant in North America (Harington, 1971). It is difficult to explain the presence of mammoths in this part of the Queen Elizabeth Islands near the peak of the Wisconsin glaciation (Prest, 1969). Perhaps the tusk was transported from a refugium to the southwest by glacial ice, sea ice or, less likely, by man. Further information on this tusk is provided by Kindle (1924) and Blake (1974a).

Comment (W. Blake, Jr.): "A search of Stefansson's diary for 1916 has failed to reveal any mention of a tusk being collected, yet Kindle (1924) specifically mentions 1916 in his report. But, on April 5, 1917, while at the northeast corner of Borden Island en route north, Stefansson wrote a letter to Capt. H. Gonzales, who was then visiting the base camp near Liddon Gulf. In it he requests that "the scientific specimens, including the mammoth tusk" should all be taken to the ship "Polar Bear", which was then at winter quarters in Victoria Island. Later he reported (Stefansson, 1918) that "We found a tusk, but no other mammoth remains, in Melville Island", but again no details of the collection site are given". (Blake, 1974a, p. 1036).

The ivory tusk, as received from the National Museum, was slightly discoloured (dark) on the surface, but otherwise the ivory was solid and in good condition. All outside parts of the tusk, as well as other places (such as cracks along growth rings) where dirt or other contamination might have entered, were removed by cutting with a band saw.

Russell Island

GSC-3994. Russell Island, 84.5 m 9360 ± 150
$\delta^{13}C = +1.5‰$

Marine pelecypod shells (sample 84-DCA-553; 19.5 g; **Hiatella arctica**; identified by D. Green) found on the surface of a washed till blanket 3.2 km from the present shoreline (Baring Channel). The intact shells were weathered and scattered over a 20 m^2 area on a till bench about 10 m above a well developed flight of raised beaches on the south-central coast of Russell Island, Northwest Territories (73°55'N, 98°14'W), at an elevation of 84.5 m (altimeter determination). Collected August 14, 1984 by D. Green, then University of Alberta, Edmonton; now Duration Mines, Toronto.

Comment (D. Green): "Sixteen radiocarbon dates on in situ bone, driftwood and shells collected from raised beaches and marine silt provide an envelope of the island's postglacial emergence. A minimum date for deglaciation on Russell Island is provided by marine shells dated at 9360 ± 150 BP (GSC-3994). However, projections of marine limit dates from the adjacent coast of Prince of Wales Island suggest that Russell Island was ice-free between 11 000 and 9800 BP.

The uppermost shorelines observed on Russell Island vary from 108 m asl on the west coast to 96 m asl on the east coast. These shorelines are significantly lower than expected, especially along the west coast where the marine limit is 80 m below that on Donnett Hill, Prince of Wales Island, only 12 km to the south. The initial rates of emergence on Russell Island also depart from that at Donnett Hill, taking a shallower form in the upper part of the emergence envelope whereas both areas show similar emergence from 7000 BP.

"The most likely explanation for the anomalously low emergence on Russell Island is that marine limit was not observed due to the small areas available at its expected elevation (ca. 170 m asl). There is also the added possibility that pervasive landfast sea ice accompanied deglaciation, hindering the formation of recognizable shorelines". (Green, 1986, Abstract). Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-4002. Russell Island, 14.7 m — 3820 ± 70; $\delta^{13}C = -24.9‰$

A single piece of driftwood (sample 84-DCA-448; 9.5 g; **Picea** or more likely **Larix** sp.; unpublished GSC Wood Identification Report No. 84-54 by H. Jetté) was found 8 km west of Krabbe Point, north-central Russell Island, Northwest Territories (74°02'N, 98°34'W), at an elevation of 14.7 m (leveled) and 560 m from the shore. The wood was partially buried in a raised gravel beach, exposed in a frost crack, in a low ridge, which is part of an extensive flight of raised beaches. Collected July 19, 1984 by D. Green.

Comment (D. Green): The date is comparable to GSC-2240 (3630 ± 60 BP, driftwood at 14.3 m; GSC XIX, 1979, p. 41) collected in 1975 by J. Savelle from northwestern Russell Island. Date for GSC-4002 is based on two 1-day counts in the 5 L counter.

Comment (W. Blake, Jr.): This sample was a small piece of wood, weathered grey, with lichen growth on the end which had been exposed. All outside wood was cut off and the wood used was mainly from the clean end, plus some weathered wood. Date is based on two 1-day counts in the 5 L counter.

GSC-3978. Russell Island, 12.1 m — 2930 ± 60; $\delta^{13}C = -24.3‰$

Driftwood (sample 84-DCA-581; 11.7 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 84-46 by R.J. Mott) partially buried in a coarse shingle raised beach ridge 200 m from the shore on a flight of beaches 3 km east of Cape Grant, northwestern Russell Island, Northwest Territories (73°56'40"N, 99°11'W), at an elevation of 12.1 m (leveled). Collected August 20, 1984 by D. Green.

Comment (D. Green): This sample and GSC-4001 (2250 ± 60 BP, this list) provide control for the lower part of the emergence curve from Russell Island.

Comment (W. Blake, Jr.): The damp wood, with lichen cover on one side and measuring 14 x 13 x 5 cm, was air dried after receipt. All outside wood, including the grey weathered part which had been exposed, was cut off; the part used had been beneath the beach shingle. Date is based on two 1-day counts in the 5 L counter.

GSC-3999. Russell Island, 12 m — 5100 ± 100; $\delta^{13}C = +1.7‰$

Marine pelecypod shells (sample 84-DCA-461; 14.0 g; **Astarte borealis**; identified by D. Green) in situ and in growth position, within a postglacial marine silt deposit exposed in a gully 4.5 km south of the coast at Krabbe Point and 1 km east of the northeast inlet of the large lake which nearly divides Russell Island, Northwest Territories (73°58'N, 98°46'W), at an elevation of 12 m (altimeter determination). Collected July 20, 1984 by D. Green.

Comment (D. Green): Using an emergence curve, this sample dates a relative sea level at approximately 26 m which is 14 m above the marine silt in which the shells were collected.

Comment (W. Blake, Jr.): This sample was expected to relate to the marine limit and to provide a date on deglaciation (cf. GSC-3994, 9360 ± 150, this list). The sample submitted comprised five paired valves and 18 other valves, all with intact periostracum and good internal lustre. The largest valve measured 2.8 x 2.2 cm; the smallest, 1.6 x 1.4 cm. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-4001. Russell Island, 8.2 m — 2250 ± 60; $\delta^{13}C = -24.6‰$

Driftwood (sample 84-DCA-503; 11.4 g; **Tsuga** sp.; unpublished GSC Wood Identification Report No. 84-49 by R.J. Mott) was partially buried between clean beach cobbles approximately 200 m from the shore on the lower section of an extensive flight of raised beaches 2 km west of Palmerston Point, northeastern Russell Island, Northwest Territories (74°06'30"N, 97°45'W), at an elevation of 8.2 m (leveled). Collected July 28, 1984 by D. Green.

Comment (D. Green): This sample and GSC-3978 (2930 ± 60 BP, this list) provide control for the lower part of the emergence curve from Russell Island.

Comment (W. Blake, Jr.): Most of the surface of this irregularly shaped but well preserved piece of wood (19 x 13 x 8 cm) was weathered grey, and it had lichen growth in places. All outside wood was cut off. Date is based on two 1-day counts in the 5 L counter.

Prince of Wales Island

GSC-3679. Browne Bay — 9470 ± 100; $\delta^{13}C = +0.5‰$

Marine pelecypod shells (sample 75-NJ-194; 38.5 g; **Hiatella arctica**; identified by J.E. Dale and W. Blake, Jr.) from the backwall of an active thermokarst slide on the west side of Beams Brook, northeastern Prince of Wales Island, Northwest Territories (73°10.5'N, 98°33'W), at an elevation of 85 m (determined by helicopter altimeter). Collected August 11, 1975 by A.S. Dyke and the late J.A. Netterville.

Comment (A.S. Dyke): The shells came from horizontally bedded sand, silt, and clay, the top of which extends to local marine limit, estimated to lie at 90 to 95 m at this site but measured nearby (Back Bay) at 95 m by survey altimeter. The sediments are interpreted as a glaciomarine deposit, and the date is considered to be an excellent control point on ice retreat to inner Browne Bay as well as on a 95 m relative sea level (Dyke, in press).

Comment (W. Blake, Jr.): The dated shells came from a particularly well preserved collection of shells, including a few paired valves and a number of individuals with intact ligament. The sample submitted to the laboratory comprised 22 left valves (nine were not quite whole) and 20 right valves (four not quite whole). Excellent external ornamentation was preserved on these elongated shells, as well as some internal lustre and some periostracum. The largest valve was 4.2 x 2.1 cm, and all shells were less than 1 mm thick. Some shells had Fe-staining. Because of the sample size and in

order to use the large counter, only the outer 10% of shell material was removed by HCl leach. Date is based on two 1-day counts in the 5 L counter.

GSC-3954. Baring Channel 9660 ± 90
$\delta^{13}C = +0.8‰$

Marine pelecypod shells (sample 84-DCA-844; 28.9 g; **Mya truncata**; identified by A.S. Dyke) from stream cut faces and the adjacent terrace top 3 km south of Baring Channel coast, 27 km east of Arabella Bay, northern Prince of Wales Island, Northwest Territories (73°45'N, 98°17'W), at an elevation of 70 to 88 m. Collected August 12, 1984 by A.S. Dyke.

Comment (A.S. Dyke): The fossiliferous sediment consisted mostly of horizontally bedded red sand with minor silt and with conspicuous dropstones, some of boulder size. The deposit was laid down on a steep regional slope when the ice front stood on summits 1 to 2 km, or less, to the south. The deposit extends upslope as a veneer to an elevation of about 100 m. Seven kilometres to the west marine limit is marked by a beach at 120 m. Seventy-five kilometres to the east marine limit is at 95 m and dated at 9845 ± 150 BP (S-2710; Dyke, in press). GSC-3954 and S-2710 define the time of deglaciation at the eastern end of Baring Channel.

Comment (W. Blake, Jr.): The sample used for dating, selected from the collection submitted, consisted of middle-sized **Mya** only. Two left valves, three right valves, and one pair were used; size range: 4.5 x 3.4 cm to 3.9 x 2.8 cm. Only the three right valves retained the periostracum. The shells had no pitting, but neither did they exhibit good internal lustre. Some shells were iron stained, but those with secondary calcite crusts were excluded by the collector/submitter. Date is based on one 3-day count in the 2 L counter.

Somerset Island

GSC-3081. Cape Anne 2450 ± 180
$\delta^{13}C = -24.7‰$

Walrus mandible bone (sample DCA-77-B9 (NMC-34510-B); 696.5 g; **Odobenus rosmarus**; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa), from a skeleton imbedded in gravelly sand 10 km south-southwest of Cape Anne, Somerset Island, Northwest Territories (74°02'N, 94°51'W), at an elevation of approximately 103 m. All of the bones were collected from a 10 to 20 m^2 area which was poorly vegetated. The skull was one third imbedded; other bones were more completely buried in gravelly sand. Collected August 5, 1977 by A.S. Dyke; submitted by W. Blake, Jr.

Comment (W. Blake, Jr.): The original determination, carried out on one tusk after a cast had been made of it, was 2420 ± 65 BP (S-1392; Dyke, 1979). No correction for $\delta^{13}C$ was made in this determination. The GSC determination was carried out as an inter-laboratory check on the same cranium, in this case on bone from one of the mandibles. the result, 2450 ± 180 BP, agrees closely with the Saskatchewan date (Blake, 1983b). As noted by the collector, because of the elevation at which the skeleton was found, the age was expected to be in the range of 9000 to 9500 BP. Like GSC-2951 (3510 ± 50 BP, this list) from Cornwallis Island, the walrus probably crawled inland and died, for a date on a walrus on nearby Bathurst Island, at only 53 m a.s.l., is 7320 ± 120 BP (Harington, 1975). Young ages on walrus vertebrae at high elevations have also been reported from Svalbard (Lauritzen et al., 1980; cf. Blake, 1983b). NaOH leach was omitted from sample pretreatment, which otherwise included treatment with 3N HCl and distilled water rinses to recover the collagen. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Cresswell Bay series

Four dates were obtained on a 230 cm-thick peat deposit, continuously sampled from a pit excavated into permafrost with an electric rotary jackhammer, 10 km northwest of the mouth of Cresswell River, Somerset Island, Northwest Territories (72°52.5'N, 93°37'W), at an elevation of approximately 160 m. The peat unit is underlain by laminated sand and silt. Palynology is in preparation by S.K. Short, University of Colorado, Boulder, Colorado. Collected July 15, 1977 by A.S. Dyke.

GSC-2945. Cresswell Bay (I) 1320 ± 60

Peat (sample GRL-436-0 (= DCA-77-HP3); 45.0 g dry) from 0 to 3 cm below the surface. NaOH leach was omitted from the sample pretreatment. Date is based on two 1-day counts in the 5 L counter.

GSC-3257. Cresswell Bay (II) 5100 ± 90

Peat (sample 77-DCA-HP3; 25.7 g dry) from 90 to 96 cm below the surface. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3250. Cresswell Bay (III) 7250 ± 70

Peat (sample 77-DCA-HP3; 36.2 g dry) from 180 to 188 cm below the surface. Date is based on one 3-day count in the 5 L counter.

GSC-2583. Cresswell Bay (IV) 7590 ± 80
$\delta^{13}C = -27.5‰$

Basal peat (sample DCA-77-HP3; 47.2 g dry) 225 to 230 cm below the surface. Date is based on one 2-day count in the 5 L counter.

Comment (A.S. Dyke): The samples were dated to provide chronological control for the first Holocene pollen diagram prepared for Somerset Island. The frozen peat was sampled in short increments using an 8 cm core barrel and increments were individually canned on site. Organic accumulation began in a wet depression about 7600 years ago and ceased because of the degradation of ice wedges and subsequent draining of the site sometime after 1300 BP. The tops of the peat mounds are presently subject to wind erosion due to the dry summer active layer. The accumulation rate decreased exponentially throughout period of record, probably due to the improved drainage at the outlet of the depression.

Comment (W. Blake, Jr.): The samples as submitted were wet. Upon oven drying the peat used for GSC-2583 (in which no wood, beetles, or seeds were noticed) decreased in weight from 643 to 208 g; GSC-3250 decreased in weight from 175.0 to 36.2 g, and GSC-3257 decreased in weight from 95.0 to 25.7 g. GSC-2583, -2945, and -3257 all contained noticeable amounts of sand.

Baffin Island

Pond Inlet series

Marine pelecypod shells at a site or sites near the hamlet of Pond Inlet, Baffin Island, Northwest Territories. Two of the age determinations were on shells from a collection made by B.G. Craig, formerly GSC, in 1963. The third collection, made by Constable W.G. MacGregor, RCMP, in 1923 may have been made at the same site as Craig's collection or it may have been made nearby.

GSC-1570. Pond Inlet (I) 80 ± 220
$\delta^{13}C = -0.1‰$

Marine pelecypod shells (sample CD/P.I.-29.7.63; 8.15 g; **Mytilus edulis**; identified by W. Blake, Jr.) from the modern beach 1.6 to 2.0 km southwest of the hamlet of Pond Inlet, Baffin Island, Northwest Territories (72°41'N, 78°02'W), at an elevation of less than 2 m. Collected July 29, 1963 by B.G. Craig; submitted by W. Blake, Jr.

GSC-1898. Pond Inlet (II) 340 ± 90
$\delta^{13}C = +1.6‰$

Marine pelecypod shells (sample CD/P.I.-29.7.63; 26.2 g; **Mytilus edulis**; identified by W. Blake, Jr.) from the modern beach as described above (same site, same collection).

GSC-1583. Pond Inlet (III) 1210 ± 330
$\delta^{13}C = -0.1‰$

Marine pelecypod shells (sample MacGregor-P.I.-1923; 2.0 g; **Mytilus edulis**; identified by W. Blake, Jr.) from the vicinity of Pond Inlet. Exact coordinates and precise locality not known, but presumably the collection was made not far from the beach where Craig collected shells 40 years later.

Comment (W. Blake, Jr.): The shells were dated as part of program of determining the ages of pelecypods collected in pre-nuclear bomb times, or believed to have been living then, as might have been the case with GSC-1570 and -1898 (cf. Blake, 1975a, Table 5). The discrepancy between GSC-1570, for which a single valve was used, and GSC-1898, for which two intact pairs were combined to make a large sample, may be that the mussels simply lived at different times. In the case of GSC-1898, the two pairs may have been of vastly different ages (for the age of GSC-1583 shows that older individuals of the same species are present in the area). The single valve used for GSC-1570 was half of the largest pair present in Craig's collection (7.6 x 4.2 cm). For GSC-1898 the shells were 7.1 and 7.2 cm in length. In all these valves the periostracum was intact except where the shells were worn at the hinge, and good interior lustre was present. For GSC-1583 eight much smaller valves were used, and no periostracum remained on the shells. In view of the age obtained it seems reasonable to assume that this collection was not made, as was Craig's, at the present shore. Because of the small sample size of GSC-1570, only the outer 10% of shell material was removed by HCl; in the case of GSC-1583 (2.0 g only) no HCl leach at all was applied. All three samples were mixed with dead gas for counting. GSC-1570 is based on one 1-day count in the 1 L counter, GSC-1583 is based on two 1-day counts in the 1 L counter, and GSC-1898 is based on two 1-day counts in the 2 L counter.

Devon Island

GSC-1661. Thomas Lee Inlet 8490 ± 100
$\delta^{13}C = +1.8‰$

Marine pelecypod shell fragments (sample BS-70-252; 26.5 g; **Mya truncata**; identified by W. Blake, Jr.) from a stream gully at the back (southwest) edge of a delta 8 km southwest of the head of the westernmost arm of Thomas Lee Inlet, Devon Island, Northwest Territories (75°32.5'N, 89°59.5'W), at an elevation of 73 to 76 m (altimeter determination). The collection was made in a zone 5 to 8 m below the surface of the delta. Collected August 13, 1970 by W. Blake, Jr.

Comment (W. Blake, Jr.): No shells were seen at higher elevations in the vicinity of this delta, and the sample is the only one dated which relates to the age of the initial Holocene marine incursion in the southwest sector of Jones Sound. The fact that considerably older shells have been found both to the northwest and to the east, suggests that the presence of late-persisting glacier ice on western Devon Island excluded the sea here; cf. GSC-866, 9260 ± 100 BP, shells at 115 m at Cape Hawes (GSC XV, 1975, p. 24; Blake, 1975a) and Y-1299, 9360 ± 160 years, shells at 60 m north of Truelove Inlet (Barr, 1971). The sample contained many well preserved intact valves, but only fragments were used for GSC-1661. The shells had no incrustation, pitting, or lichen growth, but they were characterized by some chalkiness. Many shells retained traces of the periostracum. Date is based on two 1-day counts in the 2 L counter.

GSC-1766. Cape Becher 2960 ± 130

Driftwood (sample MGG-72-18; 11.1 g dry; **Larix** sp.; unpublished GSC Wood Identification Report No. 72-34 by L.D. Wilson) partly imbedded in a gravel beach ridge (the ninth from the sea) 2.5 km east-northeast of Cape Becher, Sheills Peninsula, Devon Island, Northwest Territories (76°14.5'N, 95°19'W), at an elevation of 21 m (altimeter determination). Collected July 24, 1972 by M.G. Grosswald, Academy of Sciences of the USSR, Moscow, USSR.

Comment (W. Blake, Jr.): The date was somewhat younger than the estimated age for the elevation at which the wood was found, but the same is true of GSC-1765 (8500 ± 150 BP, this list). The group of Holocene age determinations for the Penny Strait area (six from Grinnell Peninsula, Devon Island, one from northeastern Bathurst Island), as plotted by Grosswald (1983), show that this is a region of rapid emergence. The curved piece of dry wood was 60+ cm long, had a maximum diameter of 18 cm, and was wind-worn and weather beaten. In one place some lichen growth was present, but this part of the wood was not used. Date is based on two 1-day counts in the 5 L counter.

GSC-2188. Village Bay 3680 ± 70

Driftwood (sample KI-74-Wood; 11.0 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 74-55 by L.D. Wilson) from the north side of Village Bay, Grinnell Peninsula, Devon Island, Northwest Territories (76°57.8'N, 96°43'W), at an elevation of 15 m (altimeter determination). The wood was taken from a large stump embedded in a raised beach. Collected 1974 by J.W. Kerr, then ISPG-GSC, Calgary; now Calgary).

Comment (W. Blake, Jr.): The wood was dated to obtain additional information on the rate of Holocene emergence on different parts of Devon Island (cf. GSC-1699, 4410 ± 150 years, wood at 36.5 m, Porden Point; GSC-1704, 5020 ± 140 years, wood at 25.0 m, Cape Vera; both in GSC XIII, 1973, p. 39). Compared to GSC-1766 (2960 ± 130, this list) at 21 m near Cape Becher, southern Grinnell Peninsula, the age is older than expected. All outside wood was removed from a 25 cm-long piece (3.2 x 2.0 cm in cross-section) weighing 33.6 g dry. Date is based on two 1-day counts in the 5 L counter.

Barrow Harbour series

Driftwood, marine algae, and marine shells collected from two sites southeast of the head of Barrow Harbour, Grinnell Peninsula, Devon Island, Northwest Territories.

GSC-1765. Barrow Harbour, 110 m 8500 ± 150

Marine pelecypod shells (sample MGG-72-14; 27.35 g; **Mya truncata**; identified by W. Blake, Jr.) from clayey sand on the slope of a terrace 2.7 km southeast of the head of Barrow Harbour, Grinnell Peninsula, Devon Island

(76°35'N, 95°31.5'W), at an elevation of 110 m (altimeter determination). The collected was 6 m below the surface of the terrace, in a fresh exposure in solifluction stripes. Collected July 21, 1972 by M.G. Grosswald.

GSC-1810. Barrow Harbour, 51 m — 10 200 ± 140; $\delta^{13}C = -17.7‰$

Marine algae (sample MGG-72-16c; 62.0 g dry) from a fresh exposure in a river cut through a terrace (surface at 55 m) 2 km southeast of the head of Barrow Harbour, Grinnell Peninsula, Devon Island (76°35.2'N, 95°33'W), at an elevation of 51 m (altimeter determination). The algae were interbedded with frozen sand and clay layers. The sample was collected 0.5 m behind the natural face. The surface of the terrace is made up by a layer of boulders 1.0 to 1.5 m in thickness. Collected July 22, 1972 by M.G. Grosswald.

GSC-1771. Barrow Harbour, 28 m — 6940 ± 180

Wood (sample MGG-72-17a(1); 2.8 g; **Salix** sp.; unpublished GSC Wood Identification Report No. 72-46 by L.D. Wilson) from sand exposed in the side of a terrace (surface at a maximum elevation of 35 m) 2 km southeast of the head of Barrow Harbour, Grinnell Peninsula, Devon Island (76°35'N, 95°33'W). Collected July 23, 1972 by M.G. Grosswald.

Comment (W. Blake, Jr.): These age determinations from the head of Barrow Harbour help to define an emergence curve for the Penny Strait region constructed by Grosswald (1983) on the basis of four GSC dates and three additional dates (MGU) obtained from Moscow State University, Moscow, USSR. The age of 8500 ± 150 BP (GSC-1765) for shells at 110 m is just about identical with the date obtained on marine shells close to the Holocene marine limit (delta surface at approximately 80 m) in Thomas Lee Inlet, to the southeast on Devon Island (GSC-1661, 8490 ± 100 BP, this list). If GSC-1810 (10 200 ± 140 BP) is correct, it indicates that deglaciation was earlier than indicated by the most reliable date on shells (GSC-1765), and hence the postglacial marine submergence is almost certainly above 150 m in the area. An earlier determination on a single shell fragment from 150 m north of Cape Majendie, Sheills Peninsula, gave an age of >25 000 years (GSC-1764, GSC XIII, 1973, p. 5, 39), hence 'old' shells are known to be present in the region. Two dates of 15 000 ± 300 BP (MGU-334), on shells at 150 m, and 11 640 ± 160 BP (MGU-330; both in Grosswald, 1983) on shells at 84 m, have presumably resulted from shells of different ages being mixed.

The shells used for GSC-1765 were well preserved, although mainly fragmented. All pieces used were clean or have bits of periostracum still adhering. Some of the other shells in the collection had a thin secondary yellowish precipitate. The wet seaweed sample used for GSC-1810 was dried in the electric oven, then thin matted layers of marine algae were picked out of the enclosing sand, but considerable sand was still adhering to the sample submitted. A few **Hiatella arctica** shells were also present in the sand. The well preserved single piece of willow wood used for GSC-1771 had some adhering bark and sand. The damp sample, which measured 9 cm in length and 2.5 cm in maximum diameter, was dried in electric oven. It did not appear worn, and the sand bed containing the wood also had **Mya truncata** and **Hiatella arctica** shells. GSC-1771 and -1810 both mixed with dead gas for counting. GSC-1771 is based on two 1-day counts in the 2 L counter; GSC-1765 and -1810 are both based on one 3-day count in the 2 L counter.

Northern Baffin Bay

Northern Baffin Bay series

Marine pelecypods and cirripeds dredged from the sea bottom at Station 114 of the Godthaab Expedition 1928, approximately 85 km west of the Carey Øer, Greenland, and 45 km east of Ellesmere Island, Northwest Territories (76°40'N, 76°20'W), in a water depth of 85 m. Collected August 16, 1928.

GSC-2449. Station 114 (I) — 330 ± 70; $\delta^{13}C = +2.1‰$

Cirriped shells (sample Stn. 114 - #1; 14.3 g; **Balanus balanus**; identified by the late K. Stephensen) representing six intact individuals plus possibly a few fragments from another individual. A group of 10 barnacles were living on **Chlamys islandica** (Stephensen, 1936). The shells were stored in preservative at the Zoologisk Museum, Copenhagen, Denmark, until December 1976. A 15.6 g sample was cleaned of soft parts, rinsed three times in distilled water, and air dried. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2812. Station 114 (II) — 200 ± 60; $\delta^{13}C = +1.0‰$

Marine pelecypod shells (sample Stn. 114 - #2; 26.0 g; **Astarte montagui**; identified by the late G. Thorson) from a collection of about 70 adult animals (Thorson, 1951). The sample dated comprised 62 intact pairs, with good internal lustre and no chalkiness. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): The samples were dated as part of a series collected from northern Baffin Bay and adjacent waters, in order to acquire more data on the apparent age of sea water. These samples were collected 30 years after the ones in Rice Strait (this list), but the value obtained for GSC-2812 seems somewhat too young (cf. Blake, 1975a).

Coburg Island

Coburg Island series (I)

Marine shells and marine algae from the modern shore, Coburg Island, Northwest Territories (75°52.5'N, 79°02'W), at the same site as Coburg Island Series II and III, this list.

GSC-1777. Coburg, 0 m — 270 ± 60; $\delta^{13}C = +2.7‰$

Marine pelecypod shells (sample BS-72-65; 26.0 g; **Astarte borealis**; identified by W. Blake, Jr.) from the mud/sand surface of the intertidal zone at low tide. Collected September 6, 1972, by W. Blake, Jr., D.A. Hodgson, and R.J.H. Richardson.

GSC-1778. Coburg, 0 m — modern; $\delta^{13}C = -15.9‰$

Marine algae (sample BS-72-66; 8.6 g; **Laminaria** sp.; identified by the late T. Edelstein, National Research Council, Halifax) from the mud/sand surface of the intertidal zone at low tide. The sample dated was several pieces of the stalk from a single large frond, which was complete with holdfast. Collected September 6, 1972 by W. Blake, Jr.

Comment (W. Blake, Jr.): These samples were dated in an attempt to acquire more data on the 'reservoir effect' for samples of marine origin in this area (cf. Blake, 1975a, Table 5). Even though the samples were collected several

years after the massive infusion of 'bomb' ^{14}C into the atmosphere (Lowdon and Dyck, 1974), it would appear that the shells in GSC-1777, or at least most of them, pre-dated this event. GSC-1778, on the other hand, lived just prior to its time of collection, as it showed an activity of +4.54% above modern. GSC-1778, after pretreatment with NaOH, HCl, and distilled water rinses, was mixed with dead gas for counting. Each date is based on two 1-day counts in the 2 L counter.

Coburg Island series (II)

Marine pelecypod shells, marine algae, and a walrus tusk from the upper part of a 15 m-high sea cliff exposure on the west side of the isthmus connecting Marina Peninsula with the main part of Coburg Island (75°52.5'N, 79°02'W).

GSC-1780. Coburg, 8.5 m — 8610 ± 140
$\delta^{13}C = -23.6‰$

Marine algae (sample BS-72-59; 100.0 g) collected frozen from a 1 cm-thick layer in a freshly excavated face above the highest prominent pelecypod zone. Sample dried in an electric oven in Ottawa; weight decreased from 303.5 g to 222.0 g. Pretreatment, as with wood, included NaOH and HCl leaches, plus distilled water rinses. Date is based on one 3-day count in the 5 L counter.

GSC-1420. Coburg, 7.6-7.9 m — 7760 ± 160
$\delta^{13}C = +2.5‰$

A single complete pair of marine pelecypod shells (sample BS-70-186; 25.5 g; **Mya truncata**; identified by W. Blake, Jr.), from sand above a prominent boulder zone, at an elevation of 7.6 to 7.9 m. Collected August 3, 1970 by W. Blake, Jr. Two determinations were made, after the standard pretreatment (removal of the outer 20% of shell material). The second determination is preferred, because of the better counting characteristics of the 2 L counter.

GSC-1420. First determination — 8010 ± 240

Date is based on 2 1-day counts in the 1 L counter.

GSC-1420. Second determination — 7760 ± 160

The same gas was used again. Date is based on one 3-day count in the 2 L counter.

GSC-1779. Coburg, 7.3 m — 8590 ± 110
$\delta^{13}C = +3.0‰$

Whole barnacles (sample BS-72-60; 28.1 g; **Balanus balanus**; identified by W. Blake, Jr.) from the underside of a single boulder. Collected September 6, 1972 by W. Blake, Jr. Date is based on two 1-day counts in the 2 L counter.

GSC-1541. Coburg, 7.3 m — 8240 ± 160
$\delta^{13}C = +2.5‰$

Barnacle plates (sample BS-70-83; 16.2 g; **Balanus balanus**; identified by W. Blake, Jr.) from sand beneath a prominent boulder zone, at an elevation of 7.3 m. Collected August 3, 1970 by W. Blake, Jr. Because of the small sample size, only the outer 10% of shell material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-1116. Coburg, 7.0-7.3 m — 8350 ± 140
$\delta^{13}C = +4.0‰$

Three pairs of marine pelecypod shells (sample BS-135-68; 50.0 g; **Mya truncata**; identified by W. Blake, Jr.) from within a boulder zone, overlain by sand, at an elevation of 7.0 to 7.3 m. Collected August 12, 1968 by W. Blake, Jr. Date is based on one 3-day count in the 5 L counter.

GSC-2899. Coburg, 5.1 m — 8690 ± 100
$\delta^{13}C = -17.4‰$

One tusk from a nearly complete walrus cranium (sample BS-70-163; 328.2 g; **Odobenus rosmarus**; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa), half exposed a few metres west of the section where the rest of the samples were excavated on Coburg Island. Collected August 2, 1970 by W. Blake, Jr.

Comment (W. Blake, Jr.): The age of the walrus tusk, one of only a few dated in the Canadian Arctic Archipelago (Harington, 1975; Blake, 1983a) agrees closely with the ages of marine pelecypods and marine algae nearby (e.g., **Hiatella arctica** shells, GSC-2361, 8730 ± 90 years; this series). All occur above a non-fossiliferous sand-gravel-cobble unit, which in turn overlies a sand layer containing **Mytilus edulis** (GSC-1425, >38 000; Blake, 1973, this series). The tusk was 43 cm long, but only an 8 cm-long section (5.5 to 13.5 cm from the base) was used for dating; cross-sectional measurements were 6.2 to 6.7 cm by 4.0 to 4.3 cm. The cut up and crushed ivory was treated with 6N HCl and distilled water rinses; 10.5 g of collagen gave 16.4 cm of CO_2. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 2 L counter.

GSC-2361. Coburg, 7.0-7.2 m — 8730 ± 90
$\delta^{13}C = +2.2‰$

Marine pelecypod shells (sample BS-70-182; 26.8 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the same shelly debris layer as GSC-1426 (this series). The dated sample comprised 30 left valves and 20 right valves. No periostracum was preserved on the exterior surfaces of these thin (1 to 2 mm at the hinge) aragonitic shells, but all retained good internal lustre. The shells are 1.8 to 3.2 cm in length. Date is based on one 3-day count in the 2 L counter.

GSC-1426. Coburg, 7.0-7.2 m — 8940 ± 160
$\delta^{13}C = +2.2‰$

Barnacles (sample BS-70-182; 26.1 g; **Balanus balanus**; identified by W. Blake, Jr.) from a shelly debris layer. The sample dated consisted of one intact whole barnacle (calcite) plus plates and bases of several others, all from a fresh excavation 15 to 30 cm behind the natural face. Collected August 3, 1970. Two determinations were made after the standard pretreatment (removal of the outer 20% of shell material). The second determination is preferred, because of the better counting characteristics of the 2 L counter.

GSC-1426. First determination — 8960 ± 280
$\delta^{13}C = +2.2‰$

Date is based on two 1-day counts in the 1 L counter.

GSC-1426. Second determination — 8940 ± 160

The same gas was used again. Date is based on one 3-day count in the 2 L counter.

Comment (W. Blake, Jr.): This series of age determinations were carried out to compare results on different shell species, some aragonitic, some calcitic, as well as with ivory, derived from a walrus tusk. The stratigraphically lowest faunal elements, which occur above a non-fossiliferous sand-gravel-cobble unit, are similar in age, or younger, than the oldest Holocene faunas at a number of sites to the west along the north coast of Jones Sound. This suggests that glacier ice more extensive than today persisted on Coburg Island well after the time that the sea had penetrated into Jones Sound.

Coburg Island series (III)

Marine pelecypod shells from the lower part of a 15 m-high sea cliff exposure on the west side of the isthmus connecting Marina Peninsula with the main part of Coburg Island (75°52.5'N, 79°02'W).

GSC-1425. Coburg, 5.7-6.0 m >38 000
$\delta^{13}C = +2.4‰$

Marine pelecypod shell fragments (sample BS-70-146; 46.5 g; **Mytilus edulis** (calcite); identified by W. Blake, Jr.) from a 30 cm-thick sand layer, at an elevation of 5.7 to 6.0 m. Collected July ' to August 3, 1970 by R.J. Richardson (then GSC, now Alberta Geological Survey, Edmonton, Alberta) and W. Blake, Jr. Date is based on one 4-day count in the 5 L counter.

GSC-1062. Coburg, 4.8-5.5 m >40 000

Intact individuals and fragments of marine pelecypod shells (sample BS-133-68; 41.0 g; **Hiatella arctica** (aragonite); identified by W. Blake, Jr.) from the lower 7.5 cm of a 30 cm-thick layer consisting nearly completely of a tightly packed mass of shells of this species, for the most part exceptionally robust. Approximately 30 cm above this shell-rich zone is a 30 to 60 cm-thick boulder horizon with **Lithothamnion** sp., probably **Lithothamnion lemoineae** (identified by W.H. Adey, Smithsonian Institution, Washington, D.C.; personal communication, 1974). Collected August 12, 1968 by W. Blake, Jr. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): These two age determinations, and others to be described later, show clearly that the lower units of the marine strata exposed in southern Coburg Island are of pre-Holocene age. Although **Mytilus edulis** has been recorded living today in West Greenland north of the latitude of Coburg Island (Vibe, 1950; Theisen, 1973), this distribution is a reflection of the northward flowing warm water current along the west coast of Greenland. Because the Coburg Island site is 350 km north of the known present-day limit in Canada of this species (near Pond Inlet, Baffin Island; cf. Laursen, 1946; Ellis, 1955; Ellis and Wilce, 1961; Lubinsky, 1980), the deposit was thought to date from the last interglaciation (Blake, 1973). However, a number of other age determinations, on both marine pelecypod shells and calcareous algae, have yielded finite ages in the 33 000 to 45 000 year-range, so an assignment of the lower units to a Wisconsinan interstadial may prove to be the correct alternative. Further investigation and dating are underway.

Southern Ellesmere Island

GSC-2630. Goose Fiord 370 ± 60
$\delta^{13}C = -0.3‰$

Marine pelecypod shells (sample II Fram (16.8.1901); 24.5 g; **Portlandia arctica**; identified by the late J.A. Grieg (Grieg, 1909)) dredged from a site near where the "Fram" spent the winter of 1900-1901 at the head of Goose Fiord, Ellesmere Island, Northwest Territories (76°47'N, 88°31'W), in 14 m of water. Collected August 16, 1901 by members of the 'Second Norwegian Arctic Expedition in the "Fram" 1898-1902'.

Comment (W. Blake, Jr.): This age determination is similar to two other determinations on **Astarte borealis** collected by the same expedition (GSC-1920, 400 ± 60 years, Harbour Fiord; GSC-1916, 380 ± 50 years, Rice Strait; both in this list; cf. also Blake, 1975a; Mangerud and Gulliksen, 1975). The dated sample comprised 150 whole valves and fragments. All of the aragonitic shells had intact periostracum and good internal lustre; they ranged in length between 1.5 and 2.2 cm. The shells were stored in alcohol until May 1977, when the soft parts were removed at Zoologisk Museum, Oslo, and the shells were shipped to Ottawa. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Date is based on two 1-day counts in the 2 L counter.

GSC-829. Andersrag Beach, west 39 700 ± 1300

Pelecypod shell fragments (sample BS-56-67; 42.1 g; mostly **Hiatella arctica**; identified by W. Blake, Jr.) from the ground surface west of Andersrag Beach and 8.9 km north of Cape Storm, Ellesmere Island, Northwest Territories (76°25'N, 87°36'W), at an elevation of 135 to 142 m (altimeter determination). The shells were collected from a soliflucting gentle slope of till and/or glaciomarine sediment above the highest visible beaches. Collected July 4, 1967 by W. Blake, Jr.

Comment (W. Blake, Jr.): The shells in this collection were nearly all fragmented, but most pieces were quite thick. In general the shells were characterized by little pitting, incrustations, chalkiness, or lichen growth. This sample is the only one above the level of the highest Holocene beaches at Cape Storm, but 'old' shells occur beneath the veneer of beaches as well as in till farther north up Muskox Fiord (Blake, 1975a, Table 1). Date is based on one 3-day count in the 5 L counter.

GSC-1743. Andersrag Beach, east 400 ± 140
$\delta^{13}C = +3.0‰$

Marine pelecypod shells (sample BS-1-67; 10.4 g; **Mya truncata**; identified by W. Blake, Jr.) from the surface of the modern storm beach 7 km north-northeast of Cape Storm, Ellesmere, Northwest Territories (76°24.0'N, 87°30'W), at an elevation of less than 2.0 m. The site is at the eastern end of the vast area of raised beaches known as Andersrag Beach. Collected June 17, 1967 by W. Blake, Jr.

Comment (W. Blake, Jr): This sample was dated, on the assumption that the well preserved shells had been lying on the beaches since pre-nuclear bomb days, in order to obtain data on one of the most common species found in Arctic raised marine deposits. The sample comprised three intact pairs (all still joined) plus one valve. Some periostracum and some fragments of the siphon sheath were present on all pairs, and the single valve had intact periostracum. The largest pair was 3.5 cm long, the smallest was 2.5 cm. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Cape Storm series (VII)

Marine pelecypod shells and marine algae from an exposure (GSC Fossil Locality 96377) along the north side of the river which is incised into the raised marine deposits of Andersrag Beach, 6.5 km north of Cape Storm, Ellesmere Island, Northwest Territories (76°24'N, 87°34'W), at an elevation of 63.0 m (instrumental leveling). The 20 cm-thick debris band containing shells and algae is 2.5 to 3.0 m below the top of a massive sand unit, 9.0 m below the surface of the Holocene raised beach (Blake, 1975a), and 14.5 m above the level surface of a fan near river level. The first sample was collected August 5-6, 1975; the remainder were collected August 8-9, 1977, in both cases by R.J. Richardson (then GSC, now Alberta Geological Survey, Edmonton, Alberta) and W. Blake, Jr.

GSC-2209. Cape Storm, 63 m shells (I) >34 000 $\delta^{13}C = +1.5‰$

Marine pelecypod shells (sample BS-75-176; 33.5 g; **Mya truncata**; identified by W. Blake, Jr.), including many intact, whole shells and some pairs. The thin, aragonitic shells, for the most part under 3 cm in length, were not in living position. The periostracum was intact on most shells. Date is based on one 3-day count in the 2 L counter.

GSC-2786. Cape Storm, 63 m shells (II) 40 500 ± 1660 $\delta^{13}C = +2.6‰$

Marine pelecypod shells (sample BS-77-294 and -295; 80.0 g; **Mya truncata**; identified by W. Blake, Jr.) including whole valves and fragments. These fragile and thin aragonitic shells are well preserved, with intact periostracum (plus some ligament) and good internal lustre; a few were chalky. Many that were fragmented by the time the sample was submitted to the laboratory were whole when collected. The thicker and larger valves of **M. truncata**, typical of the shells in the lower part of the section, were not used for dating. Two fractions were dated:

GSC-2786. Outer fraction 41 500 ± 1460 $\delta^{13}C = +2.4‰$

Outer half of shell material after the outermost 10% was removed by HCl leach. Date is based on one 5-day count in the 5 L counter.

GSC-2786. Inner fraction 40 500 ± 1660 $\delta^{13}C = +2.6‰$

Inner half of shell material. Date is based on one 5-day count in the 5 L counter.

GSC-2584. Cape Storm, 63 m algae (I) 40 300 ± 1550

Marine algae fragments (sample BS-77-295; 9.5 g dry; mainly **Laminaria** sp. and **Sphacelaria plumosa**; identified by R.G. Hooper, Memorial University of Newfoundland, St. John's) from the debris band. The algae, of which fragments were up to 5 cm in length, were concentrated in a more silt-rich pod within the debris band. The material used for dating was concentrated from several kilograms of sample, collected from a freshly excavated section. Because of the small sample size the NaOH leach was omitted. The sample was treated with HCl for about 1.5 hours (until there was no more reaction, presumably from adhering silt and sand, because the sample was not washed in distilled water prior to being submitted), and then given distilled water rinses. Date is based on one 4-day count in the 2 L counter.

GSC-2584-2. Cape Storm, 63 m algae (II) 37 600 ± 1200 $\delta^{13}C = -18.8‰$

Marine algae fragments (samples BS-77-294 and -295). Two more batches of the same fragmented material, weighing 3.2 and 4.0 g dry, were added. After similar treatment to that described above for GSC-2584, the resulting CO_2 was added to the CO_2 obtained from the original sample, which have been barely enough to fill the 2 L counter. Date is based on one 5-day count in the 2 L counter.

GSC-2584-3. Cape Storm, 63 m algae (III) 35 800 ± 1080 $\delta^{13}C = -18.4‰$

Marine algae fragments (samples BS-77-294 and -295). Another batch of the same fragmented material, weighing 6.1 g, was added. After similar treatment to that described above for GSC-2584, the resulting CO_2 was added to the CO_2 obtained from the three earlier burns; a total weight of 10.5 g (after pretreatment) resulted in 30.8 cm of CO_2. Date is based on one 6-day count in the 5 L counter.

Comment (W. Blake, Jr.): Because of the reasonably good agreement between the age determinations on marine algae and those on **Mya truncata** shells, and because these ages are reinforced by low amino acid ratios on **M. truncata** as well as on **Hiatella arctica** and **Macoma calcarea** (Blake, 1980a) "...suggests that the values obtained for the shells are closer to their true ages than has been the case in a number of other situations, especially those where shell fragments have been exposed on the ground surface for extended periods of time." (Blake, 1985a, p. 126). In addition, the dominant ostracod present, **Finmarchinella logani** (identified by T.M. Cronin, U.S. Geological Survey, Reston, Virginia) suggests deposition in a shallow marine environment under frigid water conditions. Further dating of individual species is underway.

Great Sandur series

Marine pelecypod shells from the modern storm beach on the west side of a major delta, informally named 'Great Sandur' after the name given by the 'Second Norwegian Arctic Expedition in the "Fram" 1898-1902' (Sverdrup, 1903), 22.4 km west of South Cape, Ellesmere Island, Northwest Territories (76°17.5'N, 85°15'W), at an approximate elevation of 1 m. Collected July 25, 1970 by W. Blake, Jr.

GSC-1464. Great Sandur (I) 300 ± 180 $\delta^{13}C = +8.0‰$

A single nearly intact valve (sample BS-70-115; 19.3 g; **Chlamys islandica**, identified by W. Blake, Jr.), one of several found lying on the surface of the beach and in swales between beach ridges. The valve was 8.0 cm high, 7.3 cm wide, and was dry and well preserved, with no pitting, incrustations, or vegetal growth. A few bryozoan colonies were present on the exterior surface. Date is based on three 1-day counts in the 1 L counter.

GSC-1897. Great Sandur (II) 150 ± 70 $\delta^{13}C = +3.1‰$

A second nearly intact valve (sample BS-70-115(B); 19.1 g; **Chlamys islandica**; identified by W. Blake, Jr.) collected as outlined above. This valve was 8.1 cm high and 7.4 cm wide, and was dry and well preserved, with no pitting, incrustations, or vegetal growth. The shell retained good internal lustre. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): These shells were dated, on the assumption that they had been lying on the beaches since pre-nuclear bomb time, as another way of approaching the problem of the apparent ages of pelecypods in the eastern Queen Elizabeth Islands. The young ages show that this boreal-subarctic species (Lubinsky, 1980) has occurred north of its present range in the very recent past, and may well live in Jones Sound today.

South Cape Fiord series (III)

Marine pelecypod shells from two sites west and north of South Cape Fiord, Ellesmere Island, Northwest Territories. Collected July 8, 1967 by W. Blake, Jr.

GSC-830. South Cape Fiord, north 8930 ± 140

Mya truncata shells (sample BS-75-67; 55.3 g; identified by W. Blake, Jr.) from 13.2 km north of the snout of Sydkap Glacier's 1959 position at the head of South Cape

Fiord (cf. Glenister, 1963), southern Ellesmere Island, Northwest Territories (76°40.5'N, 85°12'W), at an elevation of approximately 90 m (altimeter determination). The in situ shells (some still in living position) were in silt exposed by gullying in the side of a delta whose surface is at approximately 115 m.

GSC-871. South Cape Fiord, northwest — 9170 ± 150

Whole shells and fragments (sample BS-71-67; 52.5 g; **Mya truncata**; identified by W. Blake, Jr.) from the ground surface and up to 15 cm depth in silt exposed by stream gullying adjacent to an unnamed glacier 0.5 km west of inner South Cape Fiord, southern Ellesmere Island, Northwest Territories (76°31.5'N, 85°12'W), at an elevation of approximately 96 m (altimeter determination). The elevation of the top flat beach in the vicinity, which probably represents the position of sea level at the time the molluscs were living, is at 104+ m. This site is some 16.9 km south of the site where GSC-830 (this series) was collected.

Comment (W. Blake, Jr.): These two age determinations (first reported with smaller error terms; see footnote to Table 1 in Blake, 1975a) are similar to two dates north of the head of nearby Muskox Fiord (GSC-1448, 9020 ± 230 BP and GSC-1518, 8910 ± 110 BP; both in GSC XV, 1975, p. 22-23). They show that the innermost part of South Cape Fiord was ice free by 9000 radiocarbon years ago, and at that time the snout of Sydkap Glacier, the main outlet glacier from Sydkap Ice Cap, was at least 13.5 km north of the position it occupied in 1959 (and 1967). The aragonitic shells at both these sites were well preserved; many whole valves retained the periostracum and parts of the siphon sheaths were still intact. No pitting or incrustations. Each date is based on one 3-day count in the 5 L counter.

GSC-1092. Harbour Fiord, north — 7190 ± 160

Marine pelecypod shells (sample BS-84-68; 23.3 g; **Hiatella arctica**; identified by W. Blake, Jr.) from 7.2 km north of the head of Harbour Fiord, southern Ellesmere Island, Northwest Territories (76°43'N, 84°32'W), at an elevation of 68 to 70 m (altimeter determination). The shells are from the farthest north site in this valley. The shells were found in a 30 cm-thick stony sandy silt unit exposed approximately 6.7 m above river level in the edge of a terrace. Above the shell bearing unit are bedded sand and silt and then up to 1 m of sand and gravel. Collected July 23, 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): The date provides a minimum age for the deglaciation of the valley north of Harbour Fiord. Surprisingly, although the shells are at similar elevation to collections of the same species north of the head of the neighbouring fiords, the age is more than 1000 years younger. Either an outlet glacier from the Sydkap Ice Cap persisted much later in this valley, or the oldest shells were not found. Most of the shells in this well preserved collection were paired. The shells were hard, exhibited little chalkiness, and had no incrustations or pitting. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-1920. Harbour Fiord, south — 400 ± 60; $\delta^{13}C = +1.0‰$

Marine pelecypod shells (sample II Fram (22.7.1899); 27.5 g; **Astarte borealis**; identified by the late J.A. Grieg (Grieg, 1909)) dredged from the site where the "Fram" spent the winter of 1899-1900 in 'Vinterhavn', Harbour Fiord, Ellesmere Island, Northwest Territories (76°30'N, 83°55'W), in 16 m of water. Collected July 22, 1899 by members of the 'Second Norwegian Arctic Expedition in the "Fram" 1898-1902'.

Comment (W. Blake, Jr.): This age determination agrees closely with one on the same species from Rice Strait (GSC-1916, 380 ± 50 years, Blake, 1975a) and with one on **Portlandia arctica** from Goose Fiord (GSC-2630, 370 ± 60 years, this list; cf. also Mangerud and Gulliksen, 1975). The dated sample consisted of six pairs, all intact, joined, and still closed. The periostracum was present on all valves. The two largest pairs were 3.5 x 2.9 cm, the smallest pair was 2.8 x 2.5 cm. The shells were stored in alcohol until May 1973, when the soft parts were removed at Zoologisk Museum, Oslo, Norway, and the shells were shipped to Ottawa. Date is based on two 1-day counts in the 2 L counter.

Grise Fiord Settlement series

Marine shells from two sites near the settlement of Grise Fiord, Ellesmere Island, Northwest Territories.

GSC-1204. Grise Fiord Settlement (I) — 8960 ± 150; $\delta^{13}C = +3.8‰$

Barnacle shells (sample BS-12-68; 24.9 g; **Balanus** sp., probably **Balanus balanus**; identified by W. Blake, Jr.) from 1.0 km northeast of the settlement of Grise Fiord, southern Ellesmere Island, Northwest Territories (76°25'N, 82°52'W), at an elevation of 63.5 m (leveled). The shells were from a 30 cm-thick band, in sand, underlying a 75 cm-layer of beach gravel. Both units contained some boulders, probably derived from the scree slopes above, and the front of the beach ridge was somewhat deformed by downslope movement, although it could not be classified as a solifluction lobe. Intact valves of **Hiatella arctica**, including numerous juvenile individuals, occurred with the barnacles.

GSC-1147. Grise Fiord Settlement (II) — 10 300 ± 190

Pelecypod shell fragments (sample BS-93-68; 16.0 g; no species recorded) from an exposure along a stream 4.0 km south of the settlement of Grise Fiord, southern Ellesmere Island (76°23'N, 82°47'W), at an elevation of 88 to 95 m (altimeter determination). The shell fragments were collected from sand and gravel in the most southerly 'embayment' with raised beaches along the east side of Grise Fiord, in an area where the highest beaches are at approximately 107 m. The shells were from a 1.2 m-high stream cut through the beaches as well as from the ground surface (sand) in an abandoned channel of the stream. Collected July 30, 1968 by G. Cox (then McGill University, Montreal, now CRREL, Hanover, New Hampshire) and W. Blake, Jr.

Comment (W. Blake, Jr.): Date GSC-1204 can be accepted without question, as the barnacles and associated pelecypod shells were intact and extremely well preserved. The fragments making up GSC-1147, on the other hand, could not be identified readily as to species; all were less than 1 cm in size. Also, this date is older than most others along the south coast of Ellesmere Island (cf. GSC-1037, 10 100 ± 240, this list). As the collection site is in a position where a glacier advancing southward out Grise Fiord could easily move shells (or shell fragments) into the 'embayment' (cf. Blake, 1975a, 1985b), the dated sample may have contained a mixture of Holocene shells and 'old' shells. Determination GSC-1147 must be treated with caution. Because of the small size of this sample, only the outer 10% of shell material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter. GSC-1204 is based on one 2-day count in the 2 L counter.

GSC-1039. Grise Fiord 8630 ± 180

Marine pelecypod shells (sample BS-72-68; 38.8 g; **Hiatella arctica;** identified by W. Blake, Jr.) from 7.2 km north of the head of Grise Fiord, southern Ellesmere Island, Northwest Territories (76°49.5'N, 83°53'W), at an elevation of approximately 67 m (altimeter determination). The shells were from the farthest north site discovered in this valley. They occurred in silt exposed in a gully 1 to 1.5 m above the level of the alluvium filling the main valley. The shell-bearing silt was overlain by non-fossiliferous stony marine clay (or till?) and gravel. Collected July 19, 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): The date provides a minimum age for the deglaciation of this valley and is similar to a date of 8650 ± 180 years (GSC-1043, this list) from the valley north of Starnes Fiord, the next fiord to the east. The well preserved shells, mostly paired, intact, and some with periostracum, were extracted from a freshly excavated face. After washing in stream water they were dried in foil over a gasoline stove at base camp. The shells were somewhat soft and chalky. The outer 40% of shell material was removed by HCl leach. Date is based on one 3-day count in the 2 L counter.

GSC-1043. Starnes Fiord, north 8650 ± 180

Marine pelecypod shells (sample BS-76-68; 25.3 g; **Hiatella arctica;** identified by W. Blake, Jr.) from 4.8 km north of the head of Starnes Fiord, southern Ellesmere Island, Northwest Territories (76°51.5'N, 82°44'W), at an elevation of approximately 70 m (altimeter determination). The shells occurred in a 1.2 m-thick band of silt overlying non-fossiliferous silt and overlain by gravel in an 11 m-high exposure in a river terrace. Collected July 20, 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): The date provides a minimum age for the deglaciation of this valley and is similar to a date of 8630 ± 180 years (GSC-1039, this list) from the valley north of Grise Fiord, the next fiord to the west. The well preserved shells were mostly paired. Some siphon sheaths were present and many retained the periostracum. The damp shells were quite chalky and soft; after being scraped clean they were air dried. Date is based on one 3-day count in the 2 L counter.

GSC-1184. Starnes Fiord, northeast 8370 ± 170
$\delta^{13}C = +0.3‰$

Marine pelecypod shells and fragments (sample BS-77-68; 12.5 g; **Hiatella arctica** and **Mya truncata;** identified by W. Blake, Jr.) from 11.3 km north of the head of the unnamed northeast arm of Starnes Fiord, southern Ellesmere Island, Northwest Territories (76°47.5'N, 81°42'W), at an elevation of 65 to 72 m (altimeter determination). The shells were from the farthest north site in this valley. They occurred partly imbedded in pebbly silt and sand; others were loose on the face or had accumulated at the base of the terrace which rises about 10 m above the present surface of the valley alluvium. The shell-bearing unit is overlain by gravel. Collected July 21, 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): The date provides a minimum age for the deglaciation of this valley. Although the collection is from the same elevation, the shells may be slightly younger than shells collected north of Starnes Fiord (8650 ± 180, GSC-1043) and Grise Fiord (8630 ± 180, GSC-1039, both in this list), suggesting that an outlet glacier may have remained in this valley a little longer, or that the oldest shells were not found. The shells were thin but well preserved with bits of periostracum, especially on the whole shells. No pitting, chalkiness, or incrustations were present. Because of the small sample size, only the outer 5% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 2-day count in the 2 L counter.

GSC-1026. Anstead Point 9040 ± 180

Marine pelecypod shells (sample BS-4-68; 19.3 g; **Hiatella arctica;** identified by W. Blake, Jr.) from 4.0 km northwest of Anstead Point, southern Ellesmere Island, Northwest Territories (76°29.5'N, 81°37'W), at an elevation of approximately 95 m (altimeter determination). The shells occurred on sand, gravel, and cobbles in the stream bottom, in part immersed in shallow water. Collected June 19, 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): The date provides a minimum age for the deglaciation of this part of the coast of southern Ellesmere Island, and is within 10 m of the limit of Holocene marine submergence. The shells were washed clean of adhering sand and were dried on foil in a frypan. Some shells appeared to have spots of adhering algae or lichens, but these were not utilized. Date is based on two 1-day counts in the 2 L counter at 1 atm.

GSC-1066. Fram Fiord >37 000

Marine pelecypod shells (sample BS-87-68; 30.0 g; **Hiatella arctica;** identified by W. Blake, Jr.) from 8.4 km north-northeast of the head of Fram Fiord, southern Ellesmere Island, Northwest Territories (76°37'N, 81°06'W), at an elevation of ? m (altimeter determination). The shells were from the farthest north site discovered in this valley. They occurred in a stiff dark grey silty clay unit, with stones, exposed in a terrace 2.1 to 2.4 m above river level. The clay is overlain by sand. Collected July 25, 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): The collection was believed to be of Holocene age, as are shells in the valleys north of each of the other fiords along the south coast of Ellesmere Island. Obviously, at this site, an older generation of marine deposits was sampled, or 'old' shells have been reworked into a Holocene deposit (cf. Blake, 1975a, Table 1). The shells were well preserved, although some were characterized by bluish-black staining and chalkiness. A few valves were still paired, and many valves were intact. The sample was washed clean of adhering sediment in the field and dried in foil over a gasoline stove. Date is based on one 3-day count in the 2 L counter.

Jakeman Glacier series (I)

Marine pelecypod shells collected from an "island" in the river along the northwest side of Jakeman Glacier, southeastern Ellesmere Island, Northwest Territories (76°30.5'N, 80°55'W), at an elevation of approximately 20 m (altimeter determination). The "island" is protected by an icing from further erosion by the river, at least for a part of each summer. The age determinations reported here are on shells from the lowermost exposed strata above bedrock, on the northwest side of the "island".

GSC-1037. Jakeman Glacier (I) 10 100 ± 240

Pelecypod shell fragments (sample BS-28-68; 17.6 g; **Hiatella arctica;** identified by W. Blake, Jr.) from the lower 1 m (approximately) of a silty gravel unit which in places overlies bedrock directly but elsewhere is separated from the bedrock by a layer of till or stony marine silt (resembling till and without shells). The shell-bearing gravel grades upward to shell-rich sandy bands and silt with abundant shells and some marine algae. Collected July 3, 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): The shells, which were fairly well preserved, although most were fragments and all shells were quite chalky (some bits of periostracum remain), are

similar in age to GSC-1147, 10 300 ± 190 BP, from south of Grise Fiord settlement (this list). Both dates are roughly 1000 years older than other dates around Jones Sound on the earliest Holocene sediments. Because the sample may have contained a few 'old' shells together with Holocene shells (cf. GSC-2280, 9260 ± 100 BP, this series), the result must be treated with caution. The shells were characterized by little or no encrustations, lack of pitting, and no adhering lichens, etc. Some shells were discoloured. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2280. Jakeman Glacier (II) 9260 ± 100
$\delta^{13}C = +1.1‰$

Marine shell fragments plus two intact valves (BS-70-24; 27.9 g; **Hiatella arctica;** identified by W. Blake, Jr.) from a fresh exposure (larger than in 1968) of a basal diamicton interpreted as being till or glaciomarine silt. Collected July 4, 1970 by W. Blake, Jr. and R.J. Richardson.

Comment (W. Blake, Jr.): This sample was collected and dated to verify the result obtained on the 1968 collection of shells (GSC-1037, 10 100 ± 240 BP, this series). The result for GSC-2280 is more in line with other early Holocene dates around Jones Sound, so possibly GSC-1037 contained a mixture of mainly Holocene shells with a few 'old' shells. The other alternative, less likely, is that the 1970 collection was made slightly higher in the section than was the 1968 collection. The well preserved shells (largest 4 x 2 cm) retained some periostracum and ligament, plus internal lustre. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 5 L counter.

GSC-1170. Cory Glacier 6490 ± 180
$\delta^{13}C = -24.1‰$

Organic sediment and peat (sample BS-131-68; 13.5 g) from approximately 1.0 km southwest of the southwest margin of Cory Glacier, southeastern Ellesmere Island, Northwest Territories (76°14'N, 80°04'W), at an elevation of 10.0 m (leveled). The peat, which contained mosses, marine algae and other organic constituents (unpublished GSC Bryological Report No. 12 by M. Kuc, formerly GSC) as well as a rich assemblage of freshwater, brackish-water and marine diatoms (unpublished GSC Diatom Report No. 71-10 by S. Lichti-Federovich and M.R. Sreenivasa) is believed to have accumulated in a lagoonal environment between beach ridges. The dated layer was the uppermost 2.5 cm in a sequence of at least four organic bands. Collected August 11, 1968.

Comment (W. Blake, Jr.): The peat/organic sediment, because it accumulated in a lagoonal environment, provides a close approximation for the sea level of the time. Together with dated driftwood farther west along the south coast of Ellesmere Island, the sample shows that the 6500 year-old strandline rises to the west (Blake, 1975a). NaOH leach omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-1055. Cape Norton Shaw 33 900 ± 1360

Marine pelecypod shells (sample BS-47-68; 12.2 g; intact individuals and fragments of **Hiatella arctica**, and fragments of **Mya** sp., probably **Mya truncata;** identified by W. Blake, Jr.) from 7.6 km north of Cape Norton Shaw, southeastern Ellesmere Island, Northwest Territories (76°31.5'N, 78°22'W), at an elevation of approximately 60 m (altimeter determination). The shells, from the surface of eroded outwash, may have been washed out of beach material or from shell-bearing till. Collected July 5, 1968 by W. Blake, Jr.

Comment (W. Blake, Jr.): Raised beaches occur up to approximately 75 m a.s.l. (altimeter determination) in a narrow zone between two outlet glaciers, but the shells obviously derive from an older generation of marine deposits, such as those which occur elsewhere in the Jones Sound region (Blake, 1970, 1973, 1975a). Although there were some thick shells in the collection, only thin (mostly **Hiatella**) shells were used for the age determination. The shells were hard and clean; only a few showed the slightest trace of chalkiness or incrustations. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

East-central Ellesmere Island

Rock Basin Lake series (II)

Sample of modern vegetation were collected from a south-facing slope on the north side of 'Rock Basin Lake' (informal designation). This lake occupies a deep depression in a hill abutting the south side of Ekblaw Glacier at the head of Baird Inlet, Ellesmere Island, Northwest Territories (78°29.5'N, 76°46.8'W), at an elevation of approximately 305 to 310 m. Collected June 25, 1981 by W. Blake, Jr.

GSC-3680. Rock Basin Lake (I) modern
$\delta^{13}C = -25.8‰$

Woody stems of crowberry (sample BS-81-178; 11.3 g; **Empetrum nigrum;** identified by W. Blake, Jr.). The sample was air dried in the field after collection. Date is based on one 1-day count in the 5 L counter.

GSC-4200. Rock Basin Lake (II) modern
$\delta^{13}C = -30.5‰$

Woody stems of blueberry (sample BS-81-177; 11.8 g; **Vaccinium uliginosum;** identified by W. Blake, Jr.). The sample was air dried in the field after collection. Date is based on one 1-day count in the 5 L counter.

Comment (W. Blake, Jr.): The samples were dated as part of a series to determine: 1) whether living vascular plants, algae, and mosses around selected ponds and lakes in east-central Ellesmere Island had 'apparent ages' and 2) the $^{13}C/^{12}C$ ratios, so as to better interpret ratios obtained on various constituents in the lake sediment cores themselves (cf. Hyvärinen, 1985; Hyvärinen and Blake, 1981; GSC XXV, 1986a, p. 23-24).

Moraine Pond series, Baird Inlet

Aquatic moss at the sediment/water interface and moss-rich sediment from a pond, informally named 'Moraine Pond', situated in a moraine on the south side of Baird Inlet, Ellesmere Island, Northwest Territories (78°29.5'N, 76°31.5'W), at an elevation of 300 m (altimeter determination).

GSC-3476. Moraine Pond, surface moss modern
$\delta^{13}C = -22.8‰$

Aquatic moss (sample Bot. Coll. #2-1982; 20.0 g; **Drepanocladus exannulatus;** identified by J.A. Janssens, University of Minnesota, Minneapolis, Minnesota) growing at the sediment/water interface in 'Moraine Pond'. The sample was dredged from the bottom on a hook. The ice thickness was 90 to 100 cm, and the maximum water depth was 2 m. Collected May 27-28, 1982.

Comment (W. Blake, Jr.): The sample was dated as one of a series to check the age ('apparent age') of present day elements of the vegetation, and to determine the $^{13}C/^{12}C$ ratio so that ratios obtained from lake sediment cores could be better interpreted. A previous determination of the

$^{13}C/^{12}C$ ratios on a sample of the same moss species (sample Bot. Coll. #4-1980; 0.7 g) collected June 6-7, 1980 by W. Blake, Jr., gave a value of -21.0‰. In that case, although the sample was assigned a laboratory number, GSC-3128, no counting was carried out. GSC-3476 received the normal pretreatment with NaOH, HCl (no reaction), and distilled water rinses. Date is based on two 1-day counts in the 5 L counter.

GSC-3009. Moraine Pond, basal sediment — 8540 ± 170; $\delta^{13}C$ = -24.3‰

Basal moss-rich organic sediment (sample BS-79-45 (2: 98-102 cm); 14.8 g dry) from a 113 cm-long core collected from the center of 'Moraine Pond'. Collected June 18, 1979 by H. Hyvarinen (University of Helsinki, Helsinki, Finland), R.N. McNeely (then Water Quality Branch, Environment Canada, Ottawa; now GSC), R.J. Richardson (now Alberta Geological Survey, Edmonton), and W. Blake, Jr.

Comment (W. Blake, Jr.): The dated material was mainly matted layers of the moss **Drepanocladus lycopodioides** var. **brevifolius** (identified by J.A. Janssens) that extended across the core. The date is slightly younger than the basal organic material in nearby 'Rock Basin Lake' (Blake, 1981a). A preliminary report on the pollen from this pond has been made by Hyvärinen (1985). The sample was given an extra HCl leach first to test for the presence of carbonates in the base of the core (no reaction), followed by the standard treatment with NaOH, HCl, and distilled water rinses. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3600. Baird Inlet — 6500 ± 260; $\delta^{13}C$ = -20.3‰

Whole rib (sample BS-81-173; 717.3 g; the rib belongs to **Balaena**, **Balaenoptera**, or **Megaptera**; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa) from a small terrace in a stream channel on the north side of Baird Inlet, 11.4 km west-southwest from Wade Point, Ellesmere Island, Northwest Territories (78°30.8'N, 75°32.5'W), at an elevation of 80 m (altimeter determination). The stream cut through beaches composed of coarse sand, cobbles, and boulders. Collected June 25, 1981 by W. Blake, Jr. and J.A. Baker.

Comment (W. Blake, Jr.): At the time it was collected this small rib (total length, 88 cm; maximum cross-sectional dimension, 4.5 cm) was the highest sample of marine origin found along the north shore of Baird Inlet, and thus it was expected to provide useful information about the pattern of Holocene emergence. The rib is, however, too young for the elevation at which it was collected (cf. GSC-2913, 8190 ± 110 years, and GSC-3089, 8150 ± 80 years, both in this list). The reason for the discrepancy is unknown. The best possibility may be that the rib was transported upward by a polar bear. An alternative explanation is that perhaps in some way its age has been affected by constant wetting from the adjacent stream, although Berger et al. (1964, p. 999) stated that "there is no known natural mechanism by which collagen may be altered to yield a false age". A third possibility is that because of the extremely small amount of CO_2 produced (3.2 cm from 15.1 g of collagen burned), it was difficult to read the manometer properly (cf. Blake, 1975a). NaOH leach was omitted from sample pretreatment, which included a leach in 3N HCl and distilled water rinses. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2925. Wade Point — 7560 ± 170; $\delta^{13}C$ = +0.1‰

Marine pelecypod shells (sample BS-79-70; 8.2 g; **Macoma calcarea**; identified by W. Blake, Jr.) from silt exposed in a stream cut 2.1 km west of Wade Point, Ellesmere Island, Northwest Territories (78°32.3'N, 75°02.5'W), at an elevation of approximately 20 m. Collected June 22, 1979 by E.W. Blake (now University of British Columbia, Vancouver), J.P. Bridgland (now Parks Canada), and W. Blake, Jr.

Comment (W. Blake, Jr.): It was hoped that this sample would be as old as, or older than, shells of the same species collected about 7 km to the northeast near Alfred Newton Glacier (GSC-3103, 8930 ± 100 years; GSC XXI, 1981, p. 18) and about 10 km to the northeast at the head of Herschel Bay (GSC-2516, 8940 ± 100 years; TO-225, 8840 ± 50 years; and TO-226, 9010 ± 150 years; Blake, 1986b), but the Wade Point sample obviously relates to a lower sea level, relative to the land, than do these other samples. The dated sample comprised eight whole or partially whole left valves and 10 right valves; all these aragonitic shells were less than 1 mm in thickness, and the largest was >2.5 x 2.2 cm. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3897. MacMillan Glacier — 25 700 ± 890; $\delta^{13}C$ = +0.7‰

Marine pelecypod shells (sample 83-BS-289 plus 84-BS-160; 6.5 g; **Hiatella arctica**; identified by W. Blake, Jr.) from a site adjacent to MacMillan Glacier on the north side of Baird Inlet, Ellesmere Island, Northwest Territories (78°32.5'N, 75°20.5'W), at an elevation of approximately 145 m. The shells occur on a small ridge and on an adjacent terrace, both composed of a mixture of diamicton and sand, as well as in sand in the stream channel between the edge of the terrace and a lateral moraine along the north side of MacMillan Glacier. Collected July 1983 and July 1984 by W. Blake, Jr., K.E. Rolko, and C.D. Gault.

Comment (W. Blake, Jr.): The sample was dated because its elevation suggested that it might represent the highest Holocene shells. The resulting age suggested that the sample might be a mixture of 'old' shells with shells of Holocene age, both possibly moved upward by an advance of MacMillan Glacier. To test this hypothesis a single fragment (268 mg) of **Balanus balanus** and a single, partly intact pelecypod valve (probably **Macoma calcarea**; 255 mg; both identified by W. Blake, Jr.) from the same site were submitted to the IsoTrace Laboratory, University of Toronto. The results of 7640 ± 60 years (TO-71) and 7670 ± 100 years (TO-244) confirm that Holocene shells are indeed present and that they, together with shells of pre-Holocene age, have been moved upward by the glacier (Blake, 1985b, 1986b).

The sample used for GSC-3897 was composed, for the most part, of fragments. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 2 L counter.

GSC-2516. Herschel Bay — 8940 ± 100; $\delta^{13}C$ = -0.1‰

Marine pelecypod shells (sample BS-77-163; 31.9 g; **Macoma calcarea**; identified by W. Blake, Jr.) on the surface of deflated silt just north of the head of Herschel Bay, Ellesmere Island, Northwest Territories (78°36'N, 74°45'W), at an elevation of 11 m. Collected July 19, 1977 by W. Blake, Jr. and R.J. Richardson.

Comment (W. Blake, Jr.): This age determination and GSC-3103 (8930 ± 100 BP; Blake, 1981b; GSC XXI, 1981, p. 18) are the oldest dates obtained on Holocene marine shells along the west coast of Smith Sound. At the time that the molluscs were living, relative sea level was probably at 135 to 140 m a.s.l. (Blake, 1986b). The well preserved

aragonitic shells included a number of intact pairs. The shells were all <1 mm in thickness, and many were >2 cm in length. No periostracum was preserved, but the external ornamentation was intact and some valves retained internal lustre. The shells were not pitted or encrusted. Date is based on two 1-day counts in the 2 L counter.

GSC-3057. 'Lagoon Pond' 630 ± 70
$\delta^{13}C = -23.4‰$

Basal organic sediment (samples BS-79-4 (5: 3.5-4.0 cm/3: 4.0-5.5 cm); 72.5 g dry) from two short cores collected from a former lagoon between beach ridges at the head of Herschel Bay, Ellesmere Island, Northwest Territories (78°36.5'N, 74°44.0'W), at an elevation of 23 m (leveled). Collected May 29, 1979 by W. Blake, Jr., H. Hyvärinen, R.N. McNeely, and R.J. Richardson.

Comment (W. Blake, Jr.): The cores were taken in hope that this date would contribute to an understanding of the pattern of Holocene emergence at Cape Herschel. In spite of the fact that smaller vertical intervals were used than is usually the case, it is clear that the site had emerged a considerable time before organic sedimentation started. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

'Moraine Pond' series, Cape Herschel

Marine pelecypod shells adjacent to, and basal organic lake sediment from, 'Moraine Pond' (informal designation), on the north side of Cape Herschel, Ellesmere Island, Northwest Territories (78°36.7'N, 74°41.3'W). The pond surface is at 82.0 m, as determined by instrumental leveling.

GSC-3970. Moraine Pond (I) 7300 ± 110
$\delta^{13}C = -25.9‰$

Basal organic pond sediment (sample BS-81-3 (1: 406-414 cm); 80.0 g dry) from a core of frozen sediments. The total core length was 5.85 m (Blake, 1982). Collected May 19 and 21, 1981 by W. Blake, Jr., G.M. MacDonald (then Scarborough College, University of Toronto, West Hill, Ontario; now McMaster University, Hamilton, Ontario), F.M. Nixon, and O. Salvigsen (Norsk Polarinstitutt, Oslo, Norway).

GSC-2913. Moraine Pond (II) 8190 ± 110
$\delta^{13}C = -0.5‰$

Marine pelecypod shells (sample BS-79-137 and 138; 15.5 g; **Macoma calcarea**; identified by W. Blake, Jr.) from the ground surface, and within 2 cm of the surface, adjacent to Moraine Pond. Collected July 9, 19, and 22, 1979 by W. Blake, Jr. and E.W. Blake. Because of the small sample size only the outer 10% of shell was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3089. Moraine Pond (III) 8150 ± 80
$\delta^{13}C = +1.5‰$

Marine pelecypod shells (sample BS-79-137 and -138; 78.0 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the same collection described above. Two determinations were made, after the outer 10% of shell material was removed by HCl leach.

GSC-3089. Outer fraction 7780 ± 70
$\delta^{13}C = +1.4‰$

Date is based on one 3-day count in the 5 L counter.

GSC-3089. Inner fraction 8150 ± 80
$\delta^{13}C = +1.5‰$

Date is based on one 4-day count in the 5 L counter.

Comment (W. Blake, Jr.): The date on the basal organic sediments provides a minimum age for the onset of lacustrine conditions at the site (Blake, 1985b). The shells, which derive from near-surface sand and are being washed toward the pond continually, agree closely in age with a fragment of **Clinocardium ciliatum** extracted from the core at 532 cm depth (Blake, 1985b, 1986b). The reason for the outer fraction of the **Hiatella arctica** shells in GSC-3089 being younger is not known with certainty, although contamination by the precipitation of secondary carbonates would be one possibility.

GSC-3894 Cape Herschel airstrip 7880 ± 80
$\delta^{13}C = +0.8‰$

Marine pelecypod shells (sample 84-BS-148; 26.0 g; **Hiatella arctica**; identified by W. Blake, Jr.) from debris excavated from a trench along the south side of the airstrip at Cape Herschel, Ellesmere Island, Northwest Territories 978°37.0'N, 74°41.4'W), at an elevation of 63.0 m (leveling). Collected June 25, 1984 by W. Blake, Jr. and K.E. Rolko.

Comment (W. Blake, Jr.): The aragonitic shells are slightly younger than shells collected at 81.5 to 83.5 m nearby (cf. GSC-2913, 8190 ± 110 years, and GSC-3089, 8150 ± 80 years, this list). Thus the shells on which GSC-3894 was determined lived in a water depth of over 20 m. The shells were well preserved, although mostly fragmented. The largest intact valve was 3.0 cm long, but some fragments were from larger individuals. Nearly all fragments were <1 mm thick, with good internal lustre and well preserved external ornamentation. No pitting or incrustations were present on the submitted sample. Date is based on one 3-day count in the 2 L counter.

GSC-2525. 52 m beach 7210 ± 90
$\delta^{13}C = +2.0‰$

Marine pelecypod shells (sample BS-77-231; 26.8 g; **Mya truncata**; identified by W. Blake, Jr.) from wet sand in a stream cut on the north side of Cape Herschel, Ellesmere Island, Northwest Territories (78°37.0"N, 74°42'W), at an elevation of 52 m (leveling). Collected July 26 and 28, 1977 by W. Blake, Jr.

Comment (W. Blake, Jr.): This small collection of thin and fragile aragonitic shells, the first from the north slope of Cape Herschel, shows that sea level some 7300 to 7100 radiocarbon years ago was above the 52 m level (cf. GSC-3542, 7170 ± 70 years; this list). The sample comprised two intact pairs plus six whole valves. All shells retained some periostracum although parts of the exterior surfaces of the shells were chalky. All shells retained internal lustre. Date is based on two 1-day counts in the 2 L counter.

'Beach Ridge Pond' series

Algae, organic lake sediment from 'Beach Ridge Pond' and marine cirriped shells from the vicinity of this pond on the north slope of the Cape Herschel peninsula, Ellesmere Island, Northwest Territories (78°37.2'N, 74°42'W), at an elevation of 34.0 m (instrumental leveling).

GSC-3905. Beach Ridge Pond, algae modern
$\delta^{13}C = -28.5‰$

Sheets and globules of blue-green algae (sample Bot. Coll. No. 5-1984; 40.0 g dry; **Nostoc** sp.; identified by J.P. Smol, Queen's University, Kingston, Ontario) from water less than 30 cm deep in the northern part of 'Beach Ridge Pond'. Collected June 30, 1984 by W. Blake, Jr. After collection the sample was air dried in the field. Laboratory treatment included leaches in NaOH and HCl (slight reaction) and distilled water washes. Date is based on two 1-day counts in the 5 L counter.

GSC-2882. Beach Ridge Pond, 28-31 cm — 6020 ± 90; $\delta^{13}C = -17.4‰$

Basal organic sediment (sample BS-78-23 (10: 28-31 cm); 103.0 g dry) from 28 to 31 cm depth below the sediment/ice interface in the southern part of 'Beach Ridge Pond'. At the time of coring the site had 50 cm of snow and 11 cm of ice. Maximum core length was 35 cm (Blake, 1978). Collected May 22, 1978 by W. Blake, Jr., J.P. Bridgland, R.J. Richardson, and P.B. Smith. The 3 cm-long increment of frozen sediment weighed 410.7 g. After thawing in a beaker and oven drying overnight, the weight was reduced to 354.7 g. All pebbles (up to 4 cm in diameter) were removed by hand, and all material >1.00 mm in diameter was excluded by sieving. NaOH leach omitted from sample pretreatment. Sample mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3542. Beach Ridge Pond, barnacles — 7170 ± 70; $\delta^{13}C = +1.1‰$

Fragments of barnacle plates (sample BS-81-236, 49.0 g; **Balanus balanus**; identified by W. Blake, Jr.) from ground surface and less than 10 cm depth on the southwest side of 'Beach Ridge Pond', at an elevation of 33.0 to 33.5 m. The barnacle fragments varied in their state of preservation, but pitted or encrusted pices, those with lichen growth on their surfaces, and those whose wall pores were filled with sand were not utilized. The largest clean calcitic fragments were 3.0 to 3.4 cm long, 1.5 to 2.0 cm wide, and 3 to 4 mm thick. Collected July 7, 1981 by W. Blake, Jr. and J.A. Baker. Date is based on one 3-day count in the 5 L counter.

Comment (W. Blake, Jr.): The collection of modern algae was dated as part of a long-range program to determine if any presently-living materials give ages other than modern, and to obtain $^{13}C/^{12}C$ ratios on materials that may later make their way into the bottom sediments. GSC-2882 is one of the oldest dates obtained on pond sediments from the Cape Herschel peninsula, and GSC-3542, collected at approximately the same elevation as GSC-2822, refers to a sea level at an elevation of at least 52 m (19 m above the site; cf. GSC-2525, 7210 ± 90 years; Blake, 1982b; this list).

GSC-1918. Erik Harbour — 1180 ± 50; $\delta^{13}C = -13.8‰$

Narwhal tusk (sample No. 1 (G.H.-1972); 351.0 g; **Monodon monoceras**; identified by W. Blake, Jr.) from the east side of Erik Harbour, Ellesmere Island, Northwest Territories (78°37.5'N, 74°44'W), at an estimated elevation of 3 m above mean sea level. Collected August 15, 1972 by D. Mark for G. Holdsworth, National Hydrology Resource Institute, Environment Canada, Calgary, and W. Blake, Jr.

Comment (W. Blake, Jr.): This tusk, the lowest in elevation of a series of samples collected to determine the pattern of postglacial emergence, is also the only tusk material discovered. A 0.8 m-long section of the tusk was broken off in the field. The tusk was fairly well preserved, although the outer part was gray in colour, had a weathered appearance, and was splintered. The tusk was also fractured along growth rings, and coatings of green algae were present along all the spiral fractures. The tusk was cut into cubes of <3 cm size on a bandsaw, and all outside tusk material was removed in this way. Testing showed that an overnight bath in HCl removed the greenish coating. The fraction used for dating was isolated by treating the tusk with acetic acid until effervescence ceased. The sample was then neutralized and the remaining material, after drying, was burned in two batches of 20 g and 39 g. The date is based on two 1-day counts in the 5 L counter.

GSC-3055. Rosse Bay — 6920 ± 90; $\delta^{13}C = -18.7‰$

Unidentified whale rib (sample BS-79-134; **Balaena mysticetus**, the bowhead whale, is the best possibility, considering the size of the rib and the latitude at which it was collected; personal communication from C.R. Harington, National Museum of Natural Sciences, Ottawa) imbedded in beach gravel and sand on top of a moraine ridge on the southwest side of Rosse Bay, Ellesmere Island, Northwest Territories (78°38.0'N, 74°48.0'W), of an elevation of 54 m (leveled). Collected July 8, 1979 by W. Blake, Jr. Two determinations were made:

GSC-3055. Rosse Bay — 6920 ± 90; $\delta^{13}C = -18.7‰$

A section approximately 70 cm long from one end of the rib (hollow at the end of the 70 cm-long section, porous bone in the centre at the other end of the section), weighing 1025 g was used for this determination. A few rootlets were noticed at the open end, but these were removed by hand. The 70 cm section was cut into cubes measuring 2 to 3 cm on a side, then crushed in a rock crusher. The crushed bone was treated with 3N HCl, 1N NaOH, and distilled water rinses. The 79.1 g (moist) of collagen which was burned produced over 80 cm of CO_2 (as measured on a manometer), of which 48.8 cm was retained. When counting was to be carried out, the CO_2 was found to "dirty", so an additional treatment using the KOH method (Lowdon et al., 1977) was performed, which resulted in a reduction of gas to 24.0 cm. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 5 L counter.

GSC-3055-2. Rosse Bay — 2570 ± 220; $\delta^{13}C = -25.4‰$

Another section of the same rib used for GSC-3055 was carried out to test the effect of the flexible mold facing (latex) used by G. Fitzgerald, National Museum of Natural Sciences, Ottawa, to cover a bone or tusk prior to making a copy. Other substances are used on top of the latex to build up the cast, but only the latex comes in contact with the sample. The brand of latex being used at the time this test was conducted (late 1982) was 'Bultex', manufactured by General Latex, Inc. A 762.7 g sample was treated as described above for GSC-3055. Following crushing it was treated with 3N HCl, 1N NaOH, and distilled water rinses. Only 1.0 g of collagen was recovered for burning (and of that 0.3 g was ash); 3.0 cm of CO_2 were obtained. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): Obviously, the latex that must have made its way into the pores of the rib (GSC-3055-2) was not removed by the 'standard' pretreatment applied to bones. Not only was the age affected drastically (assuming that the small volume of CO_2 produced did not cause an error to be made in reading the manometer), but the $^{13}C/^{12}C$ ratio showed a significant change away from $-18.7‰$, which is much closer to the range of ratios normally obtained for bone collagen (cf. Blake, 1975a; El-Daoushy et al., 1978).

In addition to the value of 6920 ± 90 years obtained for GSC-3055, another section of the same rib was subjected to exhaustive testing by the IsoTrace Laboratory, University of Toronto, in order to perfect their techniques for pretreating bone samples. Their best value is 7108 ± 20 years (TO-33; Beukens et al., 1986; Litherland et al., 1986; Gurfinkel, 1987). Together the GSC and IsoTrace dates provide a valuable point for constructing an emergence curve, and the ages correspond well with the age of marine pelecypod shells at 52 m at Cape Herschel (GSC-2525, 7210 ± 90 years, this list).

GSC-3360. Leffert Glacier 8260 ± 150
$\delta^{13}C = +1.4‰$

Marine pelecypod shells (sample BS-81-278; 13.0 g; **Hiatella arctica**; identified by W. Blake, Jr.) from a pocket of sand between boulders on a lateral moraine ridge above (north of) the snout of Leffert Glacier, Ellesmere Island, Northwest Territories (78°42.4'N, 74°49'W), at an elevation of 48 m (altimeter determination). The shells were found on the ground surface and at up to 20 cm depth. Collected July 21, 1981 by W. Blake, Jr.

Comment (W. Blake, Jr.): The date indicates a time when the front of Leffert Glacier must have been behind (west of) its present position (cf. Blake, 1981b). The state of preservation of the shells varied, but all encrusted shells were excluded from the sample submitted for dating. All shells had their external ornamentation intact, and many retained their internal lustre. The dated sample comprised 36 fragments and two whole valves. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Rice Strait Pond series

Organic sediment from an unnamed pond 0.9 km west of the southern entrance to Rice Strait, Ellesmere Island, Northwest Territories (78°42.6'N, 74°43.0'W), at an elevation of 105 m (leveled). The samples were collected with a SIPRE (CRREL)-type auger powered by a gasoline motor and provided with a 7.6 cm-diameter stainless steel coring barrel (Blake, 1978, 1982b). The particular core (no. 3) from which the two lower samples were extracted was the longest collected in 1981, although some of the core was lost because of the considerable thicknesses of ice penetrated (at least 50 cm). Collected June 5, 1979 by W. Blake, Jr., H. Hyvärinen (University of Helsinki, Helsinki, Finland), R.N. McNeely (then Water Quality Branch, Environment Canada; now GSC), and R.J. Richardson (then GSC, now Alberta Geological Survey, Edmonton).

GSC-3044. Rice Strait Pond, 11-13 cm 3880 ± 80

Organic sediment (sample BS-79-22 (5: 11-13 cm); 54.3 g dry) from 11 to 13 cm below the sediment/ice interface. Organic carbon content of this increment averaged 4.4‰. NaOH leach omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3048. Rice Strait Pond, 144-151 cm 7530 ± 90
$\delta^{13}C = -15.8‰$

Organic sediment (sample BS-79-22 (3: 144-151 cm); 150.0 g dry) from 144 to 151 cm below the sediment/ice interface. Organic carbon content was highest (4.6%) in the black portion of the mottled sediment (brown, gray, and black). NaOH leach omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3000. Rice Strait Pond, 151-154 cm 12 000 ± 690
$\delta^{13}C = -18.3‰$

Basal organic sediment (sample BS-79-22 (3: 151-154 cm); 59.3 g dry) from 151 to 154 cm below the sediment/ice interface. The organic carbon content was extremely low (0.4% in the gray (5Y 6/1) fraction of this mottled gray and pale olive (5Y 6/3) sediment, and it was probably not significantly higher in the olive-coloured portion. NaOH leach omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 2 L counter.

Comment (W. Blake, Jr.): The age of the basal sediment is anomalously old when taken in regional context, and marine shells adjacent to 'Rice Strait Pond' are considerably younger (cf. GSC-3314, 8470 ± 100 years, this list). Until further investigation confirms an age of more than 9000 years, it seems reasonable to regard GSC-3000 as being the result of contamination of early Holocene sediments (with extremely low organic content) by allochthonous organic material carried in by glacier ice flowing southward in Rice Strait and the north-south valley, to the west of the strait, in which the pond is situated. GSC-3048 conforms much more closely with GSC-3314.

GSC-3314. Rice Strait 8470 ± 100
$\delta^{13}C = +1.6‰$

Marine pelecypod shells (sample BS-81-231; 27.0 g; **Hiatella arctica**; identified by W. Blake, Jr.) from sand, gravel and mud on the northwest side of 'Rice Strait Pond' (unofficial name), 0.9 km west of the southern entrance to Rice Strait, Ellesmere Island, Northwest Territories (78°42.6'N, 74°43.0'W), at an elevation of 108 m (leveled). The shells were found on the ground surface and up to 30 cm depth in the fines of sorted polygons. Collected July 6 and 18, 1981 by W. Blake, Jr., J.A. Baker and S.C. Blake (now University of Toronto, Toronto).

Comment (W. Blake, Jr.): The dated shells are the highest undisturbed shells of Holocene age collected in east central Ellesmere Island (Blake, 1986). A comparative age determination on a single left valve of **Hiatella arctica** from the same collection, using the AMS method, gave 8230 ± 70 years (TO-230). Most of the shells were fragmented and only thin (<1 mm) pieces were used for the age determination. A few shells were slightly encrusted, but they were not used. No periostracum remained, but the external ornamentation was good. Some valves exhibited internal lustre. Date is based on one 3-day count in the 2 L counter.

Rice Strait series

Marine pelecypods and barnacles dredged from a bay near Rice Strait (the bay is assumed to be Fram Haven, where the ship was anchored for the winter (Sverdrup, 1903)), Ellesmere Island, Northwest Territories (approximate coordinates: 78°45.5'N, 74°44'W), in a water depth of 40 m. The samples were collected by members of the 'Second Norwegian Arctic Expedition in the "Fram" 1898-1902'. The samples were dated to provide information on the apparent age of sea water in the Canadian Arctic Archipelago.

GSC-1916. Rice Strait (I) 380 ± 50
$\delta^{13}C = +0.9‰$

Marine pelecypod shells (sample II Fram (26.8.1898); 26.8 g; **Astarte borealis**; identified by the late J.A. Grieg (Grieg, 1909)). After the outer 20% of shell material was removed with HCl, the sample was dissolved in H_3PO_4 to recover the CO_2 (normal treatment for shells). Date is based on one 3-day count in the 2 L counter.

GSC-2672. Rice Strait (II) 240 ± 100
$\delta^{13}C = +1.7‰$

Cirriped shells (sample II Fram (24.8.1898); 7.9 g; **Balanus crenatus**; identified by the late G.O. Sars). Because of the small sample size no HCl leach was applied. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): The result on GSC-1916 is similar to several others on shells collected by the Second Norwegian Arctic Expedition at the turn of the century

(GSC-1920, 400 ± 60 years, and GSC-2630, 370 ± 60 years, both in this list; cf. also Blake, 1975a; Mangerud and Gulliksen, 1975). The shells used for GSC-1916 comprised four intact pairs, each with periostracum and ligament. The well preserved shells retained internal lustre. The largest individual measured 3.8 x 3.2 cm; the smallest two pairs were both 3.2 x 2.7 cm. The reason for the younger age obtained for GSC-2672 is uncertain. The single individual used for the determination (plus perhaps a few pieces derived from adjacent individuals in the colony) had its soft parts intact and was stored in ethyl alcohol at the time it was recovered from Zoologisk Museum, Oslo, Norway, in 1978.

GSC-2931. Jokel Fiord 4410 ± 120
$\delta^{13}C = +2.1‰$

Marine pelecypod shells (sample BS-79-63; 13.0 g; **Mya truncata**; identified by W. Blake, Jr.) from silt exposed in a fresh cut along a small creek 5.5 km north of the head of Jokel Fiord, Ellesmere Island, Northwest Territories (78°48.7'N, 78°07.5'W), at an elevation of less than 5 m. The site is on the east side of the fiord. Collected June 21, 1979 by W. Blake, Jr.

Comment (W. Blake, Jr.): At the time of reporting, this collection is the only one available from Jokel Fiord, hence the date may not represent the earliest Holocene incursion of the sea to the head of Jokel Fiord. The aragonitic shells in this collection were only moderately well preserved as many showed some degree of encrustation. These shells were excluded from the sample submitted for dating. This sample consisted of five whole or nearly intact valves, four left and one right. The largest (left) valve was 4.6 x 3.1 cm in size, and up to 2 mm in thickness; the smallest, 3.5 x 2.4 cm. All shells retained some degree of internal lustre and some periostracum. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2897. Beitstad Fiord 5520 ± 90
$\delta^{13}C = +1.0‰$

Marine pelecypod shells (sample BS-79-55; 22.6 g; **Mya truncata**; identified by W. Blake, Jr.) from a fresh exposure of greenish-gray silt near the base of a delta 1.8 km northeast of the head of Beitstad Fiord, Ellesmere Island, Northwest Territories (79°04.3'N, 78°48'W), at an elevation of 7 m (altimeter). The delta surface near its front has an elevation of 35 m. Collected June 21, 1977 by W. Blake, Jr. and E.W. Blake.

Comment (W. Blake, Jr.): The date on these aragonitic shells, from the only collection made in Beitstad Fiord, provides a minimum for deglaciation. Like other dates from near the heads of Jokel Fiord (GSC-2931, 4410 ± 120 years) and Flagler Bay (GSC-3929, 4990 ± 70 years, both in this list), the age is much younger than the dates on marine shells reported by Hodgson (1985) from the western side of the ice cap at Irene Bay. Of course the possibility exists that older shells are present at the heads of the east coast fiords, but they simply have not been found. The shells submitted to the laboratory were fragments, although whole shells were present in the collection. The shells lacked periostracum and lustre, but neither were they pitted or encrusted. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3929. Sverdrup Pass 4990 ± 70
$\delta^{13}C = +1.4‰$

Marine pelecypod shells (sample 84-BS-192; 23.5 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the surface of silt on a terrace (underlain by bedrock) in Sverdrup Pass 4.5 km west-southwest of the head of Flagler Fiord, Ellesmere Island, Northwest Territories (79°09.0'N, 78°26.0'W), at an elevation of 35 m (altimeter determination). Collected July 4, 1984 by W. Blake, Jr. and K.E. Rolko.

Comment (W. Blake, Jr.): These were the highest shells found during a one-day visit to Sverdrup Pass, and they may relate to a sea level as high as 50 m, as that is the elevation of a nearby delta surface. As noted in the write-up for GSC-2897 (5520 ± 90 years, shells near the head of Beitstad Fiord), the age of these shells is far younger than the dates reported by Hodgson (1985) for shells at 70 m near Irene Bay at the west end of Sverdrup Pass (e.g., GSC-1978, 8820 ± 80 years; cf. also GSC XXV, 1986a, p. 24). Encrusted shells were excluded from the sample, most of which consisted of fragments. Because of the small sample size of GSC-3929, only the outer 10% of shell material was removed by HCl leach. Date is based on one 3-day count in the 2 L counter.

GSC-3432. Cliff Edge Pond 9130 ± 160

Basal organic pond sediment (sample BS-81-47 (2: 62-68 cm); 86.6 + 47.5 g dry) from 62 to 68 cm below the sediment/water interface in 'Cliff Edge Pond', southern Bache Peninsula, Ellesmere Island, Northwest Territories (79°02'N, 75°04'W), at an elevation of 370 m (altimeter determination). The material used for dating included both banded sediment and mosses (**Drepanocladus exannulatus**; unpublished Bryological Report No. 482 by J.A. Janssens, University of Minnesota, Minneapolis, Minnesota). Total core length was 83 cm, and the core bottomed in sand. Collected June 9, 1981 by W. Blake, Jr., G.M. MacDonald, O. Salvigsen, and J.A. Baker.

Comment (W. Blake, Jr.): The age of this sample shows that the southernmost part of eastern Bache Peninsula was free of glacier ice by 9000 radiocarbon years ago. A more recent determination, on moss fragments only (**Drepanocladus revolvens**; personal communication from J.A. Janssens, 1986) from a longer core taken in 1984 (sample 84-BS-8 (5: 83-84 cm); 42 mg) is 8340 ± 70 BP (TO-309), as determined by accelerator mass spectrometry. For GSC-3432 the NaOH leach was omitted from sample pretreatment and the sample showed a moderate reaction with HCl. Sample was mixed with dead gas for counting. Date is based on one 1-day count plus one 3-day count in the 2 L counter.

GSC-2937. Cape Henry 6920 ± 140
$\delta^{13}C = +2.5‰$

Marine pelecypod shells (sample BS-79-179; 12.1 g; **Mya truncata**; identified by W. Blake, Jr.) from beach gravel, cobbles and fines 2.5 km southwest of Cape Henry, eastern Bache Peninsula, Ellesmere Island, Northwest Territories (79°07.6'N, 74°40.5'W), at an elevation of 62 m (altimeter determination). Collected July 18, 1979 by W. Blake, Jr. and E.W. Blake.

Comment (W. Blake, Jr.): The age of this sample is significantly younger (2000 years) than the oldest shells at Cape Herschel, 35 km to the south. Many of the aragonitic shells in this collection were moderately to severely encrusted with a calcareous precipitate. The shells used were either free of encrustations or the thin encrusting layer was removed by scraping with a knife. Each shell used was the truncated end of **Mya truncata** (14 right valves, 11 left valves). Some shell margins were rounded, presumably by wave action. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2679. Cape Shott 6580 ± 90
$\delta^{13}C = +1.8‰$

Marine pelecypod shells (sample 17742; 28.4 g; **Mya truncata**; identified by F.J.E. Wagner) from approximately 2.8 km southwest of Cape Shott, on the west side of the mouth of Dobbin Bay, Ellesmere Island, Northwest Territories (79°36.4'N, 73°14'W), at an elevation of 31 m. Collected August 9 and 10, 1950 by V.K. Prest; submitted April 1978 by W. Blake, Jr.

Comment (W. Blake, Jr.): This collection, representing the highest shells found in a traverse up a stream gully, were probably in part from the ground surface, partly imbedded, to judge from the variations in preservation. **Hiatella arctica** was also present in the collection, although only **Mya truncata** was used for dating. The dated material comprised six left valves, two right. The largest valve measured 4.5 x 3.1 cm; shell thicknesses were 2 mm in places. After adhering dirt was removed from the best quality shells, they were cleaned in a sonic bath. Most of these aragonitic shells were somewhat pitted and stained, but none used had secondary coatings. No lustre remained but several valves retained fragments of periostracum.

Judging by the age determinations in the area between Baird Inlet and Bache Peninsula, it seems likely that these shells do not represent the oldest Holocene material in the vicinity of Dobbin Bay. Date is based on one 3-day count in the 2 L counter.

Pim Island

Proteus Lake series

Samples of aquatic moss and organic lake sediment (algal gyttja) from the northern basin of Proteus Lake, Pim Island, Northwest Territories (78°41.7'N, 74°23.0'W), at an elevation of approximately 390 m (lake surface). The dated samples were extracted from lake sediment cores recovered from the frozen surface of the lake using a modified Livingstone sampler; ice thickness was 304 cm; water depth was 10.9 m. Collected June 12, 1979 by W. Blake, Jr., H. Hyvärinen, R.N. McNeely, and R.J. Richardson.

GSC-3042. Proteus Lake, algal gyttja 8580 ± 90
$\delta^{13}C = -26.1‰$

Algal gyttja (sample BS-79-27 (12: 50-53 cm); 34.1 g dry) from a depth of 50 to 53 cm below the sediment/water interface in core 12. At this site, 26 m northwest of the site at which core 2 was recovered, the discrete layer of aquatic moss was missing, and was represented instead by a concentration of moss fragments in the basal gyttja. NaOH leach omitted from sample pretreatment. Date is based on one 3-day count in the 2 L counter.

GSC-2934. Proteus Lake, aquatic moss 8970 ± 190
$\delta^{13}C = -30.8‰$

Aquatic moss (sample BS-79-27 (2: 45-50 cm); 5.0 g dry; the moss is a member of the Amblystegiacae family; identified by J.A. Janssens, University of Minnesota, Minneapolis, Minnesota) from 45 to 50 cm below the sediment/water interface, at the base of the organic sediment in core 2. NaOH leach omitted from sample pretreatment. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 5 L counter.

Comment (W. Blake, Jr.): The two age determinations are in correct order in terms of the stratigraphy, although GSC-3042 came from a core in which the organic sediment was a few centimetres thicker. In preparing the sample on which GSC-3042 was determined, care was taken to exclude all moss fragments (Blake, 1981a). An additional age determination, by means of accelerator mass spectrometry (AMS), on the basal 0.5 cm of moss in a new core taken from Proteus Lake in 1981 (sample BS-81-30 (7: 52.5-53.0 cm); 118.2 mg) gave a value of 9370 ± 110 years (TO-111; Blake, 1985b). At the time of writing this is the oldest date obtained on Holocene materials along the east central coast of Ellesmere Island.

GSC-2883. Pim Island, southeast 8110 ± 220
$\delta^{13}C = -0.2‰$

Marine pelecypod shells (sample BS-79-16; 9.4 g; **Macoma calcarea**; identified by W. Blake, Jr.) from silt exposed in a stream cut at the head of a bay east of the isolated mountain on the south coast of Pim Island, Northwest Territories (78°41.4'N, 74°27.5'W), at an elevation of approximately 32 m (average of two altimeter readings). Collected June 4, 1979 by W. Blake, Jr., H. Hyvärinen, R.N. McNeely, and R.J. Richardson.

Comment (W. Blake, Jr.): The age of these thin and fragile but well preserved aragonitic shells (11 whole valves plus 42 fragments) is similar to that of shells close to the Holocene marine limit at Cape Herschel, 10.5 km to the south-southwest (Blake, 1985b, 1986b) as well as to other nearby shell samples (cf. GSC-3107 and -3286, this list). The largest intact valve was 2.6 x 1.8 cm. No periostracum was preserved, but all shells retained good internal lustre. Because of the small sample size, only the outer 10% of shell was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3107. Pim Island, southwest 8170 ± 100
$\delta^{13}C = +1.8‰$

Marine pelecypod shells (sample BS-80-8 and -10; 26.5 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the ground surface near the main stream in the valley west of the isolated mountain on the south coast of Pim Island, Northwest Territories (78°41.8'N, 74°29'W), at an elevation of 75 to 85 m (altimeter determination). Collected June 3, 1980 by W. Blake, Jr. and S. Funder, University of Copenhagen, Copenhagen, Denmark.

Comment (W. Blake, Jr.): The age of these aragonitic shells is similar to those at similar elevations at Cape Herschel, 10.5 km to the south-southwest (Blake, 1985b, 1986b) as well as to other nearby shell samples (cf. GSC-2883 and -3286, this list). The largest shell utilized measured 3.8 by 1.7 cm, and most shells are less than 1 mm in thickness. Good lustre characterized the internal surfaces of most shells, whereas exterior surfaces in some shells were chalky. Only valves with well preserved ornamentation (implying little transport) were used. Juvenile shells were also present. Some shells were badly encrusted and pitted, but only shells free of encrustations were submitted for dating. Date is based on one 3-day count in the 2 L counter.

Brevoort Island

GSC-3286. Brevoort Island 8060 ± 70
$\delta^{13}C = +1.5‰$

Marine pelecypod shells (sample BS-81-58; 42.0 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the ground surface and up to 30 cm depth in beach sand on the west side of Brevoort Island, Northwest Territories (78°41.0'N, 74°07.5'W), at an elevation of 82 m (altimeter determination). Collected June 10, 1981 by O. Salvigsen, Norsk Polarinstitutt, Oslo, Norway, J.A. Baker, and W. Blake, Jr.

Comment (W. Blake, Jr.): The shells are virtually identical in age to shells at similar elevation on the north side of Cape Herschel, 15.0 km to the southwest, as well as to two samples of shells collected to the west along the south coast of Pim Island (cf. GSC-2883 and -3107, this list). Date is based on one 4-day count in the 5 L counter.

Northern Ellesmere Island

GSC-3427. Webber Glacier 38 200 ± 1240

Wood fragments (sample H5607-5148; 9.3 g dry; **Salix** sp.; unpublished GSC Wood Identification Report No. 82-7 by R.J. Mott) collected from organic debris exposed in a shear plane at the front of Webber Glacier, Ellesmere Island, Northwest Territories (80°53'N, 82°15'W), at an elevation of 175 m. Collected July 1978 by R. Mäusbacher and D. Barsch, Geographisches Institut, Universität Heidelberg, Heidelberg, FRG.

Comment (W. Blake, Jr.): Part of this same sample was analyzed at Heidelberg (Barsch et al., 1981), and the new age determination was undertaken as an inter-laboratory check (Blake, 1983b). The sample was of special interest because there is little information on interstadial organic deposits in the high Arctic. The Heidelberg result was 37 550 ± 1420 years (H 5607-5148; and the sample as received at GSC had been boiled in 0.3N HCl, washed with hot distilled water until neutral, and dried. The prepared wood was then sealed in a plastic bag and sent to Ottawa. At the GSC the sample received the standard treatment with NaOH, HCl (no reaction) and distilled water rinses. The date is based on one 4-day count and one 3-day count in the 5 L counter.

In addition to the GSC determination, a small piece (2.9 cm long, maximum diameter 0.55 cm, and weighing 160 mg) of the original sample, also pretreated in Heidelberg, was submitted to the IsoTrace Laboratory, University of Toronto, for AMS dating. Their result was 46 460 ± 520 years (TO-191). The reason for the difference in the Toronto result from the Heidelberg and GSC results is not clear, especially as the wood sample dated at the GSC and in Toronto had been pretreated in Heidelberg.

GSC-1857. Lincoln Bay 6940 ± 120
$\delta^{13}C = +1.2‰$

Marine pelecypod shells (sample DRB 20/7-7; 8.35 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the surface of marine clay and beach deposits on the southwest side of Lincoln Bay, Ellesmere Island, Northwest Territories (82°06.7'N, 62°02'W), at an elevation of 59 m (altimeter determination). Collected July 20, 1972 by G. Hattersley-Smith (then Defence Research Board, Ottawa, now Foreign and Commonwealth Office, London, England.

Comment (W. Blake, Jr.): An earlier determination, on a single valve of **Astarte borealis** from 21 m, gave an age of 6250 ± 210 BP (GSC-1571; GSC XIII, 1973, p. 43). The present determination is more valuable, for it shows that the shoreline formed approximately 6820 to 7060 years ago is at an elevation of at least 60 m relative to the land, although this age range does not take into account any correction for the apparent age of sea water (cf. England, 1982, 1985, for data on emergence in northeastern Ellesmere Island). The dated sample included five pairs plus three fragments of single valves. The largest was 4.3 cm long and the remainder were close to the same size. All shells were somewhat chalky, but in general preservation was good and each valve retained bits of the periostracum. Adhering mud was scraped off, and there were no precipitates on the valves used. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2708. Colan Bay 5360 ± 60
$\delta^{13}C = +1.0‰$

Marine pelecypod shells (sample CB-65-1-13/S; 45.6 g; **Astarte borealis**; identified by W. Blake, Jr.) from the surface of a bedded grey silt deposit in an unnamed valley west of Colan Bay, Ellesmere Island, Northwest Territories (82°29.5'N, 62°50.5'W), at an elevation of 23 to 24 m (altimeter determination). Collected July 17, 1965 by R.L. Christie; submitted by W. Blake, Jr.

Comment (W. Blake, Jr.): The aragonitic shells were dated as part of a program of acquiring more information about past positions of sea level, relative to the land, in northern Ellesmere Island. Because of a recent age determination on driftwood in the Alert area of 5500 ± 125 years (S-1991; elevation, 35 m; Stewart and England, 1983) it would appear that the pelecypods lived in a water depth of approximately 10 m. The shells in this sample were large and well preserved; the largest was 4.4 x 3.3 cm, the smallest was 2.8 x 2.4 cm. The sample consisted of six left valves and nine right valves. There were no iron stains, incrustations, pitting, or chalkiness. Some shells were quite translucent and three retained traces of the periostracum. Date is based on one 3-day count in the 5 L counter.

Disraeli Fiord series

Driftwood and marine shells were collected at several sites along Disraeli Fiord and at one site south of the present terminus of Disraeli Glacier which flows into the head of this fiord, northern Ellesmere Island, Northwest Territories. The samples were collected in the hope that they would provide additional information as to the time that Disraeli Fiord was open to the sea, prior to the formation of the Ward Hunt Ice Shelf. All samples were collected in late July and early August 1972 by G. Hattersley-Smith, formerly Defence Research Board, Ottawa, now Foreign and Commonwealth Office, London, England.

GSC-2637. Disraeli Fiord (I) 4390 ± 60
$\delta^{13}C = +1.2‰$

Marine pelecypod shells (sample DRB 2/8-3; 46.2 g; **Mya truncata**; identified by W. Blake, Jr.) from site G on the west side of the valley and 4 km south of the snout of Disraeli Glacier in Disraeli Fiord (82°40.2'N, 72°36'W), at an elevation of less than 1 m. The shells were collected from the shore of a narrow body of glacial meltwater (believed to be tidal) between the glacier to the east and the valley side to the west.

Comment (W. Blake, Jr.): The date relates to a period when the glacier snout was at least 4 km behind (south of) its present position. The well preserved shells were aragonitic. Date is based on two 1-day counts in the 5 L counter.

GSC-2226. Disraeli Fiord (II) 4390 ± 60

Driftwood (sample DRB-3/8 A; 11.0 g; **Larix** sp.; unpublished GSC Wood Identification Report No. 75-29 by L.D. Wilson) from site H on the east side of Disraeli Fiord (82°45.5'N, 72°45'W), at an elevation of less than 0.7 m. The collection site was 4.8 km north of the snout of Disraeli Glacier.

Comment (W. Blake, Jr.): This age determination indicates a time when the Ward Hunt Ice Shelf either did not exist, or was much reduced in size, so that driftwood could float into Disraeli Fiord. The wood as received was damp but firm and well preserved; it was dried in an electric oven. Small amounts of mold and lichens were cut away. The piece of wood was 29 cm long, and 1 cm thick. Date is based on one 3-day count in the 5 L counter.

GSC-2292. Disraeli Fiord (III) 3940 ± 60
$\delta^{13}C = -24.5‰$

Driftwood (sample DRB-3/8 B; 11.2 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-29 by L.D. Wilson) from site H on the east side of Disraeli Fiord (82°45.5'N, 72°45'W), at an elevation of less than 0.7 m. The collection site was 4.8 km north of the snout of Disraeli Glacier.

Comment (W. Blake, Jr.): This date is one of the youngest reported (in this series) from Disraeli Fiord, but it is not as young as the date of 3000 ± 200 BP (L-254D; Lamont III, 1956, p. 9; Crary, 1960; Hattersley-Smith, 1972; Blake, 1972).

GSC-2357. Disraeli Fiord (IV) 3980 ± 60
$\delta^{13}C = -26.5‰$

Driftwood (sample DRB-3/8 C; 10.4 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-29 by L.D. Wilson) from site H on the east side of Disraeli Fiord (82°45.5'N, 72°45'W), at an elevation of less than 0.7 m. The collection site was 4.8 km north of the snout of Disraeli Glacier.

Comment (W. Blake, Jr.): This age determination is nearly identical with the previous one (GSC-2292) in this series, and the same comments apply with regard to the age of the ice shelf. The wood was dry and firm and measured 21 x 3.3 x 1.2 cm. All the outer wood (particular care was taken where there were lichens on the surface) was cut away. Date is based on two 1-day counts in the 5 L counter.

GSC-2398. Disraeli Fiord (V) 3830 ± 140
$\delta^{13}C = -24.3‰$

Driftwood (sample DRB-3/8 D; 7.0 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-29 by L.D. Wilson) from site H on the east side of Disraeli Fiord (82°45.5'N, 72°45'W), at an elevation of less than 0.7 m. The collection site was 4.8 km north of the snout of Disraeli Glacier.

Comment (W. Blake, Jr.): This age determination is similar (perhaps slightly younger, although the error term is considerably larger) to the two previous ones (GSC-2292 and -2357) in this series, and the same comments apply with regard to the age of the ice shelf. On the younger side (3690 BP) this age determination is the one that comes closest to the dates of 3000 ± 200 BP (L-254D) and 3400 ± 150 BP (L-254A; both in Lamont III, 1956, p. 9), although it should be noted that the original pieces came from the opposite side of the fiord, and were found close to the ice shelf. All of the pieces of wood in the present series which are approximately 4000 years old or slightly younger came from site H. The dry, firm wood used for GSC-2398 was the smallest of the four in this collection: 16 x 2 x 1 cm. Date is based on two 1-day counts in the 2 L counter.

GSC-1850. Disraeli Fiord (VI) 8130 ± 120
$\delta^{13}C = +1.4‰$

Marine pelecypod shells (sample DRB 29/7-3; 14.7 g; **Mya truncata**; identified by W. Blake, Jr.) from the east side of an unnamed river on the west side of Disraeli Fiord (82°47.5'N, 73°56'W), at an elevation of 51 m. The shells were collected from the surface of a marine clay deposit, approximately 6 km from the river mouth.

Comment (W. Blake, Jr.): This sample is the oldest of the Holocene-age materials collected by Hattersley-Smith around Disraeli Fiord. The date is nearly identical to the age of shells collected west of Yelverton Inlet (GSC-2403, 8120 ± 80 BP, this list) and to the age of driftwood collected earlier in the same unnamed fiord (GSC-1534; 8150 ± 140 BP; Blake, 1972; GSC XIII, 1973, p. 43). Older driftwood has, however, been reported from Clements Markham Inlet to the east (S-2211, 8915 ± 115 BP; S-2210, 8545 ± 110 BP; both in Stewart and England, 1983; Bednarski, 1986). Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-1794. Disraeli Fiord (VII) 5930 ± 60
$\delta^{13}C = -23.8‰$

Driftwood (sample G.H.-S. 24/7-8; 11.65 g; **Larix** sp.; unpublished GSC Wood Identification Report by R.J. Mott) from the south edge of a major delta on the west side of Disraeli Fiord (82°49'N, 73°45'W), at an elevation of 23 m (altimeter determination).

Comment (W. Blake, Jr.): Assuming that the wood has not moved since deposition, and that the elevation determination is accurate, this wood provides an approximation for the position of the sea, relative to the land, some 5850 to 5990 years ago. This dry crooked piece of wood was 60 cm long, and 2 to 3 cm in diameter. There was a considerable lichen growth, so all the outside wood was cut off. A whitish material, of unknown origin, was noted along some of the annual rings. Date is based on one 3-day count in the 5 L counter.

GSC-2047. Disraeli Fiord (VIII) 5300 ± 60
$\delta^{13}C = -26.1‰$

Driftwood (sample DRB-29/7-2; 11.5 g; **Larix** sp.; unpublished GSC Wood Identification Report No. 74-26) from the south edge of a major delta on the west side of Disraeli Fiord (82°49.5'N, 73°45'W), at an elevation of 8 m (altimeter determination).

Comment (W. Blake, Jr.): This dry and well preserved piece of wood, found on the surface of the delta, obviously does not date the 5300 year-old shoreline (cf. GSC-1794, 5930 ± 60 BP at 23 m, this series). The single piece used for dating was 31 cm long, 1.5 x 2.5 cm in maximum diameter. All adhering mud and a few spots of lichen were cut off. Date is based on one 3-day count in the 5 L counter.

GSC-1831. Disraeli Fiord (IX) >42 000

Driftwood (sample DRB 24/7-1; 12.0 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 72-45 by R.J. Mott) collected at the foot of a bank eroded in marine clay on the north edge of an extensive delta on the west side of Disraeli Fiord (82°50.3'N, 73°42'W), at an elevation of 0.3 to 0.5 m. The samples at this site were collected below the level of present tidal and ice-push action.

Comment (W. Blake, Jr.): The submitter noted that it was likely that the samples at this site have been washed down from a somewhat higher level, and then they may have been redeposited at the shore. In view of the age, re-deposition from an unknown site or elevation would seem to be a certain, although 'old' driftwood has also been recorded in northeastern Ellesmere Island (cf. GSC-1632, >41 000 BP and GSC-1678, >40 000, both from northwest of the head of Discovery Harbour; England, 1974; GSC XIX, 1979, p. 45). The wet sample was oven dried; prior to drying the wood was slightly damp and had a moldy smell. All outside wood and wood along cracks in this curved piece was cut off. Date is based on two 1-day counts in the 5 L counter.

GSC-1823. Disraeli Fiord (X) 6220 ± 80
$\delta^{13}C = -22.3‰$

Driftwood (sample DRB 24/7-2; 11.35 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 72-45 by R.J. Mott) collected from the same site as described for GSC-1831 (this series) on the west side of Disraeli Fiord (82°50.3'N, 73°42'W), at an elevation of 0.3 to 0.5 m.

Comment (W. Blake, Jr.): This sample is one of two Holocene driftwood samples (out of five) dated at this site. The 24.5 cm long sample (5 cm maximum diameter) was still slightly damp when cut up. This piece had rounded ends, was somewhat rotten on the outside, and had some adhering mud and rootlets. The inside wood was solid, once the outside wood and wood along cracks was removed. Date is based on one 1-day count in the 5 L counter.

GSC-1885. Disraeli Fiord (XI) >42 000

Driftwood (sample DRB 24/7-3; 12.8 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 72-45 by R.J. Mott) collected from the same site as described for GSC-1831 (this series) on the west side of Disraeli Fiord (82°50.3'N, 73°42'W), at an elevation of 0.3 to 0.5 m.

Comment (W. Blake, Jr.): The same comments apply here as in the case of GSC-1831. After being stored partly dry this sample of solid wood (29 cm long, 8 cm in maximum diameter) was oven dried and all outside wood and wood along cracks was cut off. Date is based on two 1-day counts in the 5 L counter.

GSC-1806. Disraeli Fiord (XII) 5180 ± 70
$\delta^{13}C = -23.3‰$

Driftwood (sample DRB 24/7-5; 11.5 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 72-45 by R.J. Mott) collected at the same site as described for GSC-1831 (this series) on the west side of Disraeli Fiord (82°50.3'N, 73°42'W), at an elevation of 0.3 to 0.5 m.

Comment (W. Blake, Jr.): This age determination was one of two Holocene-aged wood samples out of the five dated at this site, and this is the younger of the two Holocene samples (cf. GSC-1823, 6220 ± 80 BP, this series). The sample was collected wet and stored partly dry. Date is based on two 1-day counts in the 5 L counter.

GSC-1862. Disraeli Fiord (XIII) >40 000

Driftwood (sample DRB 24/7-6; 12.6 g; **Pinus** sp. (**strobus** type); unpublished GSC Wood Identification Report No. 72-45 by R.J. Mott) collected at the same site as described for GSC-1831 (this series) on the west side of Disraeli Fiord (82°50.3'N, 73°42'W), at an elevation of 0.3 to 0.5 m.

Comment (W. Blake, Jr.): This sample, like GSC-1831 (>42 000 years old) and GSC-1885 (>42 000 years old, both in this series) is beyond the limit of radiocarbon dating. Clearly 'old' wood is common in the area, and the comments made with regard to GSC-1831 apply equally well here. This solid but wet piece was partly dried, then oven dried at the time it was submitted to the laboratory. All outside wood and adhering mud were removed from this curved piece, 23 cm long and with a maximum diameter of 8 cm. Date is based on two 1-day counts in the 5 L counter.

GSC-2733. Disraeli Fiord (XIV) 4550 ± 60
$\delta^{13}C = -24.1‰$

Driftwood (sample DRB 26/7-1; 11.8 g; **Larix** sp.; unpublished GSC Wood Identification Report No. 75-36 by L.D. Wilson) collected from the ground surface on the south side of a delta (site C) at the mouth of the largest river entering the east side of Disraeli Fiord (82°50.5'N, 73°15'W), at an elevation of 0.5 to 1.0 m.

Comment (W. Blake, Jr.): The three pieces of wood dated from this site (cf. GSC-2784 and -2512, this series) are all of similar age and are slightly older than the wood found further south along the east side of Disraeli Fiord. This clean and well preserved piece of wood was 41 cm long and 2.0 x 1.5 cm in cross-section. Only the outer nine growth rings were used for dating. Date is based on one 3-day count in the 5 L counter.

GSC-2784. Disraeli Fiord (XV) 4680 ± 60
$\delta^{13}C = -24.8‰$

Driftwood (sample DRB 26/7-3A; 11.5 g; **Larix** sp.; unpublished GSC Wood Identification Report No. 75-36 by L.D. Wilson) collected from the ground surface at the site described for GSC-2733 on the east side of Disraeli Fiord (82°50.5'N, 73°15'W), at an elevation of 0.5 to 1.0 m.

Comment (W. Blake, Jr.): As noted above for GSC-2733, the three pieces of wood dated from this site are all of similar age. All the wood from sample "3" appeared to derive from a single piece; 11.5 g of dry, well preserved wood was cut from the largest piece (57 cm long, 7 x 4 cm in cross-section). All outside wood was cut away and only 10 growth rings were used. Date is based on two 1-day counts in the 5 L counter.

GSC-2512. Disraeli Fiord (XVI) 4570 ± 70
$\delta^{13}C = -24.2‰$

Driftwood (sample DRB 26/7-5; 11.5 g; **Larix** sp.; unpublished GSC Wood Identification Report No. 75-36 by L.D. Wilson) collected from the ground surface at the site described for GSC-2733 on the east side of Disraeli Fiord (82°50.5'N, 73°15'W), at an elevation of 0.5 to 1.0 m.

Comment (W. Blake, Jr.): As noted above for GSC-2733, the three pieces of wood dated from this site are all of similar age, although not quite as young as wood collected near the shore farther south along the east side of the fiord. The piece used for GSC-2512 is the largest piece from site "C" (56 x 12 x 1.5 cm), it was cut from a larger piece in the field, and it was fresh-appearing. About 12 annual rings were used. Date is based on one 3-day count in the 5 L counter.

GSC-2154. Disraeli Fiord (XVII) >41 000

Driftwood (DRB 28/7-B; 10.6 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 75-27 by L.D. Wilson) from site D at the north edge of a major delta on the west side of Disraeli Fiord (82°50.5'N, 73°45'W), at an elevation of 0.3 to 1.0 m.

Comment (W. Blake, Jr.): Like GSC-1831, -1862, and -1885, all in this series and all from the same delta complex on the west side of Disraeli Fiord, the age of this piece of wood is beyond the limit of conventional dating. These four determinations suggest that there may be a source for "old" wood in the drainage basin of this unnamed river. The single piece of wood used was hard and dense (22.5 x 3.8 x 2.0 cm). Approximately 10 annual rings were used to prepare the sample, after all outside wood and wood along cracks was cut off. Date is based on two 1-day counts in the 5 L counter.

Summary comment (W. Blake, Jr.): This series of 17 age determinations shows clearly that marine pelecypods migrated into Disraeli Fiord in early Holocene time, by 8130 ± 120 years ago (GSC-1850). It seems likely that the Ward Hunt Ice Shelf was much reduced in size then, if in fact it was in existence. Certainly the front of Disraeli Glacier, if it was then further advanced than today, did not fill the outer part of the fiord, for the pelecypods had to migrate south to latitude 82°47.5'.

In addition to GSC-1850 (8130 ± 120 BP, at 51 m elevation) several dates on marine molluscs in the range between 6800 and 7900 years have been reported from Ward Hunt Island at 38 m and from south of the ice shelf but west of the mouth of Disraeli Fiord at 30 m (Crary, 1960; Lyons and Mielke, 1973). These dates suggest that the ice shelf was not then in existence.

Eleven dates on Holocene age driftwood range between 6220 ± 80 BP (GSC-1823) and 3830 ± 140 BP (GSC-2398), indicating that the Ward Hunt Ice Shelf was not in existence during the Hypsithermal maximum, or it was much reduced in size, so that there was a route by which driftwood could float into Disraeli Fiord from the open ocean (see Jeffries and Krouse, 1984). The four dates on driftwood reported by Crary (1960) ranged from 6120 ± 150 BP (L254C) to 3000 ± 200 BP (L254D). At 4390 ± 60 years ago (GSC-2637) the front of Disraeli Glacier was probably at least 4 km south of its present position.

West of Yelverton Inlet series

Driftwood and marine pelecypod shells collected at two sites on the west side of a delta which has been built into an unnamed fiord west of Yelverton Inlet, Ellesmere Island, Northwest Territories. The site is 2+ km from the fiord. Collected July 31, 1975 by M. Oliver for W. Blake, Jr. and H. Trettin.

GSC-2403. West of Yelverton Inlet (I) — 8120 ± 80; $\delta^{13}C = -24.3‰$

Driftwood (sample TMMO-St. 8; 11.7 g; **Larix** sp.; unpublished GSC Wood Identification Report No. 76-27 by L.D. Farley-Gill) from the ground surface (82°01.3'N, 81°57.5'W), at an elevation of 84 m (altimeter determination). The dimensions of the piece submitted were 37 x 5 x 2.5 cm. All outside weathered wood, with some lichen, was cut off. Date is based on one 3-day count in the 5 L counter.

GSC-2458. West of Yelverton Inlet (II) — 7890 ± 80; $\delta^{13}C = +1.8‰$

Marine pelecypod shells (sample 75TMMO-St. 10; 26.4 g; **Mya truncata**; identified by W. Blake, Jr.) from the ground surface of silt (82°01.5'N, 81°57.5'W), at an elevation of 75 m (altimeter determination). The shells in this collection were large (up to 6.4 cm in length) and robust. The sample submitted was one of two intact pairs; 5.2 x 4.2 cm in size with no incrustations and much of the periostracum still intact. Date is based on one 3-day count in the 2 L counter.

Comment (W. Blake, Jr.): The age of the wood is nearly identical to that of a driftwood log from 76 m farther south in the same fiord (GSC-1534, 8150 ± 140 years; Blake, 1972; GSC XIII, 1973, p. 43), confirming that the mouth of the fiord was not blocked by shelf ice 8060 to 8200 years ago. The pelecypods used for GSC-2458 apparently lived in a water depth of less than 9 m.

GSC-3960. Cape Bourne — >30 000; $\delta^{13}C = +2.1‰$

Marine pelecypod shells (sample 84051101; 10.5 g; **Mya truncata**; identified by W. Blake, Jr.) from mounds on the surface of the sea ice 2 km east of Cape Bourne, Ellesmere Island, Northwest Territories (81°53'N, 91°00'W), at sea level. The mounds were believed to have formed by the dredging action of the ice on the sea bed, as the ice is thought to be frozen to shoals below. Tidal action dredges up sediment, forcing it up into tide/strand cracks. This particular collection site was an old frozen exposure. Collected May 11, 1984 by M.O. Jeffries, then University of Calgary, Calgary; now Geophysical Institute, University of Alaska, Fairbanks, Alaska.

Comment (M.O. Jeffries): Ancient shells have been reworked by recent nearshore sea ice growth and deformation.

Comment (W. Blake, Jr.): The sample submitted to the laboratory was a single intact pair, although part of the margin of the left valve had been broken off. This procedure eliminated the danger of shells of different ages being dated. Measurements: 4.5 cm long, 3.7 cm high; most of the shells are 1 to 2 mm thick, but they were thicker in the hinge area. Good internal lustre remained and the external ornamentation was well preserved, but there was no periostracum. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-3940. Cape Armstrong — 60 ± 80; $\delta^{13}C = -24.2‰$

A piece of driftwood (sample 84050501; 11.4 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 84-41 by R.J. Mott) was found in the landfast sea ice about 13 km west of Cape Armstrong on the north coast of Ellesmere Island, Northwest Territories (82°05'N, 88°30'W), at sea level. Collected May 5, 1984 by M.O. Jeffries, then University of Calgary, Calgary (now University of Alaska, Fairbanks, Alaska) and H.V. Serson, Victoria, British Columbia.

Comment (M.O. Jeffries): Radiocarbon dated driftwood has been used to interpret landfast sea ice and ice shelf variations in the general region (cf. Stewart and England, 1983), and it was of interest to obtain a date for the aforementioned driftwood. This piece of wood was found in an area where little is known of variations in the landfast ice fringe and where there is little remaining ice shelf. The wood was found in rough ice quite close to shore and its date indicates that it arrived there quite recently, i.e., within the last 60 years. This agrees with the available evidence of considerable ice shelf disintegration off the north coast of Ellesmere Island since the beginning of this century.

Comment (W. Blake, Jr.): Only rarely has driftwood been collected on sea ice, so it was of interest to date this piece to see if it had any appreciable age. A piece of spruce driftwood found by H.V. Serson on the surface of multi-year sea ice in Nansen Sound was 'modern' (GSC-1793, GSC XVIII, 1978, p. 16). The present piece occurred as a tree stump frozen into ice, but most of the wood was protruding above the surface. A piece was sawn off and the wood was stored frozen in a polyethylene bag; it thawed at least once while in transit. The sample was received wet. A piece weighing 16.6 g was air dried after all the outside wood was cut off. Date is based on two 1-day counts in the 5 L counter.

Cornwallis Island

GSC-2951. Read Bay — 3510 ± 50; $\delta^{13}C = -18.7‰$

Walrus tusk (sample DE-76-1; 925.0 g; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa) from 2.6 km south-southeast of Read Bay, on the east coast of Cornwallis Island, Northwest Territories (75°01.2'N, 93°34'W), at an elevation of 170 m (stereotope determination). The walrus skull was embedded in sandy-silt with only 1 to 2 cm of the tip of one of the tusks, as well as part of the cranium, exposed. The general topography of the upland plateau is undulating, and the specimen was recovered

from a broad hollow, floored by yellow brown sandy-silt, and largely unvegetated; no gravel veneer, as is characteristic of raised beaches, is present. Collected August 14, 1976 by D.K. Elliott, M.R. Gibling, and G. Narbonne, all then of the University of Ottawa, Ottawa.

Comment (W. Blake, Jr.): Because of the elevation at which the sample was found, and the fact that the skull was embedded, an age of 9000 to 10 000 years was expected (cf. Blake, 1970; Washburn and Stuiver, 1985). However, the young age suggests that 1) a walrus crawled far inland, and that predators then dispersed the bones, or 2) a bear dragged the skull inland from the sea ice. The cranium presumably became buried by frost action and/or the downslope movement of the enclosed materials. The uncorrected age (3410 ± 50 BP) was reported in Blake (1983b). NaOH leach omitted from sample pretreatment, which otherwise included treatment with 6N HCl and distilled water rinses to recover the collagen fraction. Date is based on one 3-day count in the 5 L counter.

Bathurst Island

Purcell Bay series

A variety of materials, including marine pelecypod shells, far-travelled driftwood, wood of local origin, and mosses, have accumulated in the bottom of a valley 9.0 km northeast of a small unnamed bay on the north side of Purcell Bay, May Inlet, Bathurst Island, Northwest Territories (76°27'N, 100°03'W), at an elevation of 50 m (altimeter determination). Most of the marine shells derived from a silty layer on the ground surface adjacent to a small stream, whereas most of wood fragments and other organic detritus occurred in a more sandy layer at 5 to 20 cm below the surface. Collected July 10, 1963 by W. Blake, Jr. and August 1, 1975 by R.J. Richardson, then GSC, now Alberta Geological Survey, Edmonton, Alberta, and W. Blake, Jr.

GSC-1584. Purcell Bay (I) 7710 ± 150
$\delta^{13}C = -21.6‰$

Driftwood (sample BS-185-63; 6.6 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 71-44 by R.J. Mott) from the detritus layer. The wood used was a single flat piece of dry driftwood, 14 x 4 (max.) x 2 (max.) cm in size, brownish in colour but weathered grey on the exposed surface. The sample does not include more than 30 annual rings. Date is based on one 3-day count in the 2 L counter.

GSC-1690. Purcell Bay (II) 7790 ± 140
$\delta^{13}C = +2.5‰$

Marine pelecypod shells (sample BS-183-63; 105.9 g; **Astarte borealis**; identified by W. Blake, Jr. and confirmed by A.H. Clarke, Jr., then National Museum of Natural Sciences, Ottawa) from the ground surface or at shallow depth. The shells were well preserved with intact periostracum. Some were worn in the hinge area and some had been attacked by boring gastropods. The sample submitted for dating comprised 28 paired valves (many hinged) all 2.5 to 3.5 cm in length. Two determinations were made:

GSC-1690. Outer fraction 7730 ± 80
$\delta^{13}C = +1.4‰$

Outer half (21 to 55%) of shell material after the outermost 20% was removed by HCl leach. Date is based on one 3-day count in the 5 L counter.

GSC-1690. Inner fraction 7790 ± 140
$\delta^{13}C = +2.5‰$

Inner half (56 to 100%) of shell material. Date is based on one 3-day count in the 5 L counter.

GSC-1692. Purcell Bay (III) 8570 ± 330
$\delta^{13}C = -20.5‰$

Periostracum (sample BS-183-63; 2.4 g burned) remaining in the shell apparatus after treatment of the **Astarte borealis** shells described above (GSC-1690). This organic residue was treated with HCl and distilled water rinses prior to drying and burning. The NaOH leach was omitted. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2007. Purcell Bay (IV) 7510 ± 220
$\delta^{13}C = -27.2‰$

A single twig (sample BS-185-63A; 1.5 g dry; identified as probably being **Salix** sp.; unpublished GSC Wood Identification Report No. 74-7 by R.J. Mott) from the detritus layer. After pretreatment with NaOH and HCl and distilled water rinses, the CO_2 derived from this well preserved wood was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2009. Purcell Bay (V) 7920 ± 100
$\delta^{13}C = -28.5‰$

The single largest twig (sample BS-185-63B; 5.0 g dry; identified as probably being **Salix** sp.; unpublished GSC Wood Identification Report No. 74-7 by R.J. Mott) from the detritus layer. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 5 L counter.

GSC-2013. Purcell Bay (VI) 7650 ± 100
$\delta^{13}C = +2.4‰$

Marine gastropod shells (sample BS-183-63(A); 15.1 g; **Colus togatus**; identified by A.H. Clarke, Jr., then National Museum of Natural Sciences, Ottawa) from the detritus layer. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2816. Purcell Bay (VII) 7650 ± 100
$\delta^{13}C = +1.1‰$

Marine pelecypod shells (sample BS-75-158; 27.1 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the detritus layer. Sample submitted for dating included 19 left valves (16 whole and 3 fragments) and 17 right valves (8 whole and 8 fragments). Some individual shells are paper thin, and none are more than 1 mm thick. No periostracum is presented, but neither are the shells chalky. Some shells are translucent, some have iron stain, and some have internal lustre. The external ornamentation is intact on most valves used. The largest valve was 4.3 x 1.9 cm; the smallest, 2.8 x 1.3 cm. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): This series of different materials from the same deposit was dated to determine how the ages of marine shells compared with terrestrial materials in the same deposit, especially one such as this in an area of calcareous bedrock and sediments. The agreement between materials is good, the only exception being the small sample of periostracum (GSC-1692) and, as has been pointed out earlier, this somewhat anomalous result may simply be because of the large mix with dead gas that was necessary; frequently anomalous ^{14}C ages occur in connection with low CO_2 yields (Blake, 1975a). Dating of some other components at this site is continuing via AMS dating. A 300 mg willow twig has given an age of 7380 ± 60 years (TO-188), an age which is reasonably close to the dates reported here, but a 353 mg sample (14 valves) of fragile **Portlandia arctica** shells from the same sample has given a value of 8310 ± 80 years (TO-227). The most reasonable explanation for the difference is that the **Portlandia arctica** shells date from the

time of the earliest marine incursion into this valley, and the shells have been reworked into a deposit containing mostly younger materials as the land emerged from the sea.

Cameron Island

GSC-2513. Cameron Island 4990 ± 70
$\delta^{13}C = -24.5‰$

Wood from a log (sample Panarctic-1; 11.8 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 77-19 by L.D. Farley-Gill) from a sample lying loose on the gravel surface of a dry river bed near the northeast corner of Cameron Island, Northwest Territories (76°24'40"N, 103°05'09"W), at an elevation of 11.0 m. Collected October 1976 for W. Blake, Jr. by L. Jones, J. McGillicky, and N. Simpson, all of Panarctic Oils, Ltd., Calgary, Alberta; submitted by C.R. Hetherington of the same company.

Comment (W. Blake, Jr.): The sample submitted to the laboratory for dating, as examined by R.J. Richardson, was part of a root end of a log. The sample received was 40 cm long and had a maximum diameter of 20 cm. Approximately 25 to 30 annual rings from the outer part of the log were used for dating. This 5000 year-old sample refers to a sea level at least 11 m higher than present (relative to the land), and the log may well have been washed by stream action to a lower elevation than that at which it was deposited originally (cf. Blake, 1970). It is the first log collected from Cameron Island. Date is based on one 3-day count in the 5 L counter.

Seymour Island

Seymour Island series

Driftwood logs were collected from three sites on Seymour Island during the course of a study of ivory gull nesting sites, by the National Museum of Natural Sciences, Ottawa (MacDonald, 1976). Collected July 1974 by S.D. MacDonald, of that institution and R.A. Popko, then of the University of Guelph, Guelph, Ontario; submitted by W. Blake, Jr.).

GSC-2121. Seymour Island (I) 2600 ± 50

A piece of driftwood (sample SDMacD-74-1; 9.6 g dry; **Picea** sp.; unpublished GSC Wood Identification Report No. 74-58 by L.D. Wilson), from the surface of a beach ridge near the southwest corner of Seymour Island, Northwest Territories (76°47.5'N, 101°18'W), at an approximate elevation of 12 m. This piece was the smallest of the three wood samples. Dimensions: 21 cm long, 5.5 x 3.5 cm maximum cross-section. The wood tapered, was weathered grey, and it had been etched by the wind. The part with lichen growth was not used for dating, nor was the punky wood. All outside wood and wood along cracks was cut off. Date is based on one 3-day count in the 5 L counter.

GSC-2176. Seymour Island (II) 1200 ± 60
$\delta^{13}C = -24.6‰$

Driftwood (sample SDMacD-74-3; 12.6 g dry; **Larix** sp.; unpublished GSC Wood Identification Report No. 74-56 by L.D. Wilson) from the central part of the northern coast of Seymour Island, Northwest Territories (76°48.0'N, 101°17.5'W), at an approximate elevation of 10 m. This dry and well preserved piece of wood, imbedded in moss, was 47 cm long, and 6.8 x 4.0 cm (maximum) in cross-section. The lichen-covered part of the wood was not submitted to the laboratory. All outside, weathered, wood and wood along cracks was cut off. Date is based on two 1-day counts in the 5 L counter.

GSC-2198. Seymour Island (III) 880 ± 60
$\delta^{13}C = -29.2‰$

A small driftwood log (sample SDMacD-74-2; 11.45 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 74-57 by L.D. Wilson), dry and well preserved in moss on the north coast of Seymour Island, Northwest Territories (78°47.8'N, 101°18'W), at an approximate elevation of 4 m. The log was 78 cm long and it was the lowest piece of driftwood collected on Seymour Island in 1974. All outside wood (with some lichens) and wood along cracks was cut off. Date is based on two 1-day counts in the 5 L counter.

Comment (W. Blake, Jr.): These three age determinations do not allow construction of the usual type of emergence curve, as the sample used for GSC-2176 is too high in elevation for its age. Perhaps this piece of wood has been pushed upward by the action of sea ice, which is intense on this coast (MacDonald, 1976). The same may be true of GSC-2198. It is clear, however, that the 5000 year-old shoreline is above 20 m in elevation (cf. Blake, 1970).

Graham Island

GSC-1590. Cape Torrens >22 000

Marine pelecypod shell (sample BS-70-236; 2.9 g; **Hiatella arctica**; identified by W. Blake, Jr.) from the ground surface 7 km north-northeast of Cape Torrens, Graham Island, Northwest Territories (77°15.5'N, 90°03'W), at an elevation of 130 m (altimeter determination). The collection was made among soft shaly debris. The abundant shells were scattered about on the ground surface or were partly imbedded. Collected August 11, 1970 by W. Blake, Jr.

Comment (W. Blake, Jr.): The sample was dated to determine whether the high level shells were of Holocene age or if they were 'old' shells which probably had been transported by glacier ice. A single right valve (4.4 x 2.0 cm) was dated to avoid the problem of mixing shells of different ages. Obviously 'old' shells are present, but whether they have indeed been transported or whether they relate to a pre-Holocene position of sea level is unclear. Nearly all of the shells in the collection are large, but not extremely thick, **Hiatella arctica** shells. Some are pitted and encrusted; others have spots of lichen, etc. The valve used was white and chalky, but was free of pitting or coatings of encrusting materials. Because of the small sample size the HCl leach was omitted. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Meighen Island

GSC-1923. Krueger River >48 000
$\delta^{13}C = -22.7‰$

Most of a tree (sample Meighen-Site I-1971; 50.0 g) collected from a peat bed exposed in a stream gully 0.8 km south of Krueger River and 4.2 km west of Hill 181, Meighen Island, Northwest Territories (79°55'10"N, 99°23'30"W), at an elevation between 70 and 80 m (from 1:50 000 map). The wood was first identified as **Picea** sp. (unpublished GSC Wood Identification Report No. 73-25 by L.D. Wilson) but further examination showed that "it is very similar to wood of **Piceaoxylon beaufortense** sp. nov. reported by Roy and Hills (1972) from the Beaufort Formation of Banks Island" (unpublished GSC Wood Identification Report No. 75-72 by R.J. Mott). The wood as received was dry and well preserved. The nearly intact 'tree' was 97 cm high, 15 cm maximum diameter at the base and 6 cm maximum diameter at the top (broken off). Two roots extended out at the base; the largest was 68 cm and the outer 46 cm of this (broken) root was used for dating. Collected July 21, 1971 by D.E. Petzold, then McGill University, Montreal.

Comment (W. Blake, Jr.): The wood was dated to determine whether any of the old organic deposits on Meighen Island were within the limit of radiocarbon dating. The site was believed to be too high for Holocene driftwood, as J.G. Fyles (personal communication) placed the limit of postglacial marine submergence at approximately 30 m. The date confirms the supposition that the wood and peat probably belong to the Beaufort Formation. A 15 cm-long piece was cut out of the root described above, and then only wood from the core of half of the diameter was used. Pretreatment included 1 hour hot NaOH leach, 1 hour hot HCl leach and distilled water rinses. Date is based on one 3-day count, one 2-day count, and one 1-day count in the 5 L counter at 4 atmospheres.

United States of America

Alaska

GSC-2144. Johns Hopkins Inlet 4750 ± 60
$\delta^{13}C = -26.2‰$

Wood (sample J.H.-1; 11.4 g dry; **Alnus** sp.; unpublished GSC Wood Identification Report No. 74-47; identification confirmed by E. Perem, Forest Products Laboratory, Environment Canada, Ottawa) imbedded in grey, compact silty to stony till on the north side of Johns Hopkins Inlet near the mouth of the Inlet, Alaska (58°55'N, 136°56'W), at an elevation of 152 m. The site is in the center of section 17, T34S, R51E, within the Mt. Fairweather D-3 Quadrangle, and directly west of Russell Island. The log was one of several logs clustered together. Collected July 18, 1974 by G.M. Haselton, Clemson University, Clemson, South Carolina.

Comment (G.M. Haselton): The date of 4750 ± 60 BP coincides closely with three age determinations on wood east of Reid Glacier some 15 km to the southeast (this list). The date confirms a middle Neoglacial ice advance throughout the upper fiords of Glacier Bay. Ice advanced out of the Fairweather Range, here and in neighboring British Columbia.

Comment (W. Blake, Jr.): GSC-2144 is also similar to three dates on wood from beneath lacustrine deposits (lakes formed by advancing ice) in the Muir Inlet area to the east (Goldthwait, 1963, 1966; Haselton, 1966).

Only the outer part of this dry and well preserved wood sample (estimated fewer than 30 annual rings) was used for dating, after the outermost wood and wood along cracks (which contained a few rootlets) was cut away. Date is based on two 1-day counts in the 5 L counter.

Reid Glacier series

Wood embedded in outwash sand and gravel exposed in a deep stream cut 0.8 km east of Reid Glacier, Alaska (58°50'N, 136°49'W). The site is in the SE¼ of section 18, T35S, R52E, within the Mt. Fairweather D-3 Quadrangle. Collected August 1974 by G.M. Haselton.

GSC-2168. Reid Glacier (I) 4720 ± 60
$\delta^{13}C = -25.2‰$

Wood (sample R-1; 11.3 g; **Betula** sp. or **Alnus** sp.; unpublished GSC Wood Identification Report No. 74-46 by L.D. Wilson; identification as **Alnus** sp. confirmed by E. Perem, Forest Products Laboratory, Environment Canada, Ottawa) in cross-bedded sand (and gravel), overlying bedrock and overlain by 30+ m of highly consolidated silty till. This log was at an elevation of approximately 30 m.

GSC-2184. Reid Glacier (II) 4610 ± 60
$\delta^{13}C = -25.4‰$

Wood (sample R-2; 11.2 g; **Alnus** sp.; unpublished GSC Wood Identification Report No. 74-48 by L.D. Wilson; identification confirmed by E. Perem) found in a mat of black peaty debris/forest litter within a 2 m-thick unit of cross-bedded sand and gravel, above bedrock, and overlain by 30 m of silty till. This sample, at an elevation of approximately 160 m, was 10 m above stream level.

GSC-2350. Reid Glacier (III) 4690 ± 90
$\delta^{13}C = -25.3‰$

Wood (sample R-3; 2.1 g; three pieces identified as **Alnus** sp.; unpublished GSC Wood Identification Report No. 76-8 by R.J. Mott) in silty peat close to (100 m) the site of sample R-2 (see stratigraphy described above for GSC-2184), but at a lower elevation (122 m).

Comment (G.M. Haselton): All three samples demonstrate Neoglacial ice overriding proglacial outwash, in which trees uprooted by the advance had been incorporated. The dates agree closely with GSC-2144 (4750 ± 60, this list), a date on wood in Neoglacial till on the north side of Johns Hopkins Inlet, some 15 km to the northwest. Together these age determinations provide strong evidence for a regional middle Neoglacial advance, when all the fiords in the upper reaches of the Glacier Bay region were filled with ice shortly after 4700 BP.

Comment (W. Blake, Jr.): An analysis of the pollen in the silty peat enclosing the wood used for GSC-2350 (unpublished GSC Palynological Report No. 76-7 by R.J. Mott) gave the following results: **Pinus** – 1 (0.5%), **Alnus** – 116 (57.1%), Umbelliferae – 1 (0.5%), Polypodiaceae – 83 (41.0%), and unidentified – 3 (1.5%). In his report Mott stated: "The above assemblage, dominated by alder (**Alnus**) pollen and fern spores (Polypodiaceae), is an odd assemblage and difficult to interpret because of this and because only one sample is involved. The alder pollen is probably from **Alnus crispa**, which grows in the area today. The fern spores resemble those of **Athyrium filix femina** and **Dryopteris austriaca**, both of which grow in the area at the present time. All three species occupy open and disturbed sites at various elevations. Therefore, open conditions are indicated but the age of the deposit is not defined. The almost complete absence of conifer tree pollen (only one grain of pine (**Pinus**)) does not suggest the extant vegetation type. Since Sitka spruce (**Picea sitkensis**), western hemlock (**Tsuga heterophylla**) and mountain hemlock (**T. mertensiana**) are all abundant in the area the absence of conifer pollen would not be expected in modern deposits".

In addition to the pollen a small subsample of the peat was examined for plant macrofossils and fossil arthropods. The former were much more rare than the latter, and J.V. Matthews, Jr. reported only seeds of **Alnus** sp. and **Rubus** sp. (unpublished GSC Plant Macrofossil Report No. 86-22). Fossil arthropods included: Coleoptera (beetles): Carabidae (ground beetles) – **Leistus** sp., **Trechus chalybeus** Dej., and **Pterostichus** sp.; Staphylinidae (rove beetles) – **Micropeplus laticollis** Makl. and **Olophrus consimile** Gyll.; Ptiliidae (feather-winged beetles) – **Acrotrichus** sp.; Scarabaeidae (scarab beetles) – **Aegialia** sp. and **Aphodius** sp.; and Curculionidae (weevils). Also present were Diptera (flies) and Oribatei (oribatid mites): **Epidamaeus** sp. and **Cepheus** typ. J.V. Matthews, Jr. commented on this assemblage as follows (unpublished GSC Fossil Arthropod Report No. 86-21): "All of the taxa in the list are expected in the area today and imply a climate similar to that of the present in the region. **Micropeplus laticollis** fossils were very abundant. The species can usually be found in deciduous leaf litter along streams. **Trechus chalybeus** is also typical of deciduous leaf litter, but sometimes occurs in open grassland areas. The fossils of the mite **Cepheus** are most similar to the species **C. corae** Jacot, which has also been recorded from humus and leaf litter. **Leistus** is a rare beetle and is seldom seen in fossil assemblages. Both **Leistus** and **Olophrus consimile** suggest that damp, thickly vegetated sites existed near the

collection site. At least two species of **Aphodius** are represented by the fossils and one species of **Aegialia**. Though **Aphodius** is generally known as a dung beetle, some species do not live in dung, preferring instead the damp detritus that occurs in animal nests and other such sites. Because the fossils in this sample could not be identified at this time, little significance should be attached to their presence. It is true, however, that **Aphodius** fossils occur in a number of contexts and their presence in samples such as this is not a surprise. **Aegialia**, the other scarab in the assemblage is a typical beetle of silty river banks."

GSC-2350 was mixed with dead gas for counting. GSC-2168 is based on two 1-day counts in the 5 L counter. GSC-2184 is based on one 3-day count in the 5 L counter, and GSC-2350 is based on one 3-day count in the 2 L counter.

Greenland

North Star Bugt

GSC-2316. Umanaq 50 ± 60
$\delta^{13}C = -0.2‰$

Marine pelecypod shells (sample Thule-2.9.40; 26.7 g; **Mytilus edulis**; identified by C. Vibe, Zoological Museum, University of Copenhagen, Copenhagen, Denmark) from individuals collected alive from the intertidal zone at lowest ebb in the vicinity of Umanaq, at the west tip of Dundas Fjeld and between Dundas Fjeld and the outpost in inner North Star Bugt, Greenland (76°33.5'N, 68°55'W). Collected September 1 to 3, 1940 by C. Vibe, then of 'den danske Thule-Ellesmere Land Ekspedition 1939-40'.

Comment (W. Blake, Jr.): The sample, one of a series which have been collected or dredged from Arctic waters, and which have since been stored in museums, was dated to gain information about the apparent ages of marine pelecypods. It is the most recently collected of the samples investigated (Vibe, 1950), and the sample has given the youngest age. The mussels were stored in alcohol immediately after collection. According to G. Høpner-Petersen (personal communication, September 1975), at the time the collection was re-examined the alcohol appeared to be the original and the mussels did not appear to have been disturbed since 1940. All the valves were well preserved, with intact periostracum, and with bits of ligament and muscle still adhering to the shells. Five pairs were used for dating; the largest measured 5.7 x 3.0 cm, the smallest (one valve only used) measured 4.6 x 2.3 cm. Although the sample was of sufficient size for the 2 L counter (after the normal 20% HCl leach), as in numerous previous samples of **M. edulis** a somewhat lower yield of CO_2 (15.7 cm) was achieved than is the case with most other pelecypod species. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

Saunders Ø

Uvdlisaitut series

Marine pelecypod shells and whale bones from a coastal section and from the surface of raised beaches above the section at Uvdlisaitut on the north coast of Saunders Ø, Greenland (76°36'N, 69°45'W).

GSC-2346. Uvdlisaitut south, 23-29 m 12 200 ± 160
$\delta^{13}C = +2.0‰$

Miniscule marine pelecypod shell fragments (sample BS-74-28; 10.5 g; fragments unidentified as to species) from the surface of beach gravel at an elevation of 23 to 29 m (altimeter determination). The collection site is the highest elevation at which raised beaches were found south of the coastal section, although higher strandlines presumably occur under the solifluction lobes which impinge on the beaches here and adjacent to which the shells were collected. Collected July 30, 1974 by W. Blake, Jr. and B.L. Johnston.

Comment (W. Blake, Jr.): Some larger fragments, identifiable as **Mya truncata** and **Hiatella arctica**, were present, but all had secondary crusts of brownish carbonate material, so they were not used (testing of the chondrophore of several **Mya** fragments showed only the presence of aragonite). The shell fragments submitted were either clean or a few tiny spots of incrustations were removed by scraping. As this date is much older than the dates on the other Holocene samples collected nearby Saunders Ø (cf. GSC-2210, 8970 ± 100 years, this series) it is interpreted as being a mixture of 'old' shell fragments with Holocene shell fragments. Taken in regional context it also seems too old; cf. M-723, 9880 ± 500 BP (Michigan IV, 1959, p. 175; a date on seaweed from inner Wolstenholme Fjord) and I-9663, 9385 ± 145 BP (Weidick, 1978a; a date on shells from a coastal cliff south of Thule Air Base). Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-2079. Uvdlisaitut east, 13.5 m 8030 ± 80
$\delta^{13}C = +1.5‰$

Marine pelecypod shells (sample BS-74-6; 33.1 g; **Mya truncata**; identified by W. Blake, Jr.) from a reddish sand unit interpreted (in the field) as being near the base of the Holocene strata. The overlying material becomes progressively coarser until it takes on the character of beach shingle. This collection and the next two listed (GSC-2210 and -2143) are from the eastern of the two sections studied. Collected July 27, 1974 by W. Blake, Jr. at an elevation of 13.5 m (leveling).

Comment (W. Blake, Jr.): The aragonitic shells in this collection were large and well preserved. Seven intact pairs were submitted for dating; the largest measured 4.8 x 3.2 cm, the smallest pair was 3.2 x 1.9 cm. All the shells retained some periostracum plus the inner end of the siphon sheath, all retained internal lustre, and all had little chalkiness. None of the shells had secondary precipitates. The aspartic acid ratio of **Mya truncata** valves from the same collection is 0.0654 (UA-1701). Because of the small sample size, for the 5 L counter, only the outer 10% of shell material was removed by HCl leach. Date is based on one 3-day count in the 5 L counter.

GSC-2210. Uvdlisaitut east, 13.0 m 8970 ± 100
$\delta^{13}C = +1.1‰$

Marine pelecypod shell fragments (sample BS-74-8; 28.3 g; **Mya truncata**; identified by W. Blake, Jr.) from a green clay underlying shell debris and the richly-fossiliferous red sand unit containing GSC-2079 (8030 ± 80 years, this series). The green clay overlies a 1 to 1.5 m-thick unit of stony, muddy till-like sediment. Collected July 27, 1974 by W. Blake, Jr. at an elevation of 13.0 m.

Comment (W. Blake, Jr.): The fragmented, thick, and chalky nature of these shells suggested that they might be 'old', especially as two dates of greater than 32 000 years (W-74 and -75) had been reported (Suess, 1954; Krinsley, 1963) on shells collected in the vicinity in 1953. All fragments used were clearly identifiable as **Mya truncata**, and nearly all fragments had part or all of the periostracum still intact. The thickest fragment (0.5 cm at the hinge) was not used.

GSC-2143. Uvdlisaitut east, 11.0-12.0 m — >40 000; $\delta^{13}C = -0.6‰$

Marine pelecypod shells (sample BS-74-9; 47.0 g; **Mytilus edulis**; identified by W. Blake, Jr.) from a gravel and sand unit which becomes non-fossiliferous upward and is overlain by a 1 to 1.5 m-thick till-like unit. Collected July 27 to 29, 1974 by W. Blake, Jr. and B.L. Johnston at an elevation of 11.0 to 12.0 m.

Comment (W. Blake, Jr.): This **Mytilus**-bearing horizon is the uppermost unit along this section of the coast from which a 'greater than' age has been obtained. Although **Mytilus** does occur at this latitude (Vibe, 1950), and the species has been recorded from still farther north along the Greenland coast (Theisen, 1973), this date is only the second age determination on pre-Holocene examples of this species around northern Baffin Bay (cf. GSC-1425, >38 000 BP, Coburg Island, this list). Almost all the shells were fragmented and many were rounded at the corners, implying transport or washing on a beach. A few nearly intact valves were found, but they tended to break as they and the enclosing gravel and sand were wet. Almost all material used for dating was blue (calcitic) shell material rather than the inner nacreous (aragonitic) layer. Date is based on one 4-day count in the 5 L counter.

GSC-2747. Uvdlisaitut west, 16.5 m — >30 000; $\delta^{13}C = +3.4‰$

A marine pelecypod shell (sample BS-74-19; 15.5 g; **Mya truncata**; identified by W. Blake, Jr.) from a greenish grey clayey layer above a gravelly, sandy cliff-forming unit (no **Mytilus** seen) and a reddish and greyish-black diamicton. This collection and the next one to be listed (GSC-2257) are both from the western of the two sections where collections were made along the north coast of Saunders Ø (Blake, 1975b). Collected July 28, 1974 by W. Blake, Jr., at an elevation of 16.5 m.

Comment (W. Blake, Jr.): In view of the elevation of this sample, and the Holocene ages already obtained nearby (GSC-2079 and -2210, this series), a Holocene age for this shell was a possibility, yet its massive nature, compared to shells of the same species already dated, suggested that it might be 'old'. A determination of the aspartic acid ratio on part of the same valve gave 0.1846 (UA-1702), a ratio which is much higher than that obtained for Holocene shells (cf. GSC-2079) nearby. The shells in this collection were fairly well preserved, although more are fragmented than are whole (**Hiatella arctica** occurred whole more often than did **Mya**). A single left valve (one edge broken off) 5.7 cm long and 2+ mm thick (5 mm thick at the hinge) was used for dating. The periostracum was intact at the posterior end, there was slight chalkiness, and the aragonitic shell retained its internal lustre. There was no pitting nor were secondary precipitates present. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2257. Uvdlisaitut west, 9.0 m — >39 000; $\delta^{13}C = -15.7‰$

Whale bone (sample BS-74-20 (bone); 1580 g dry) from a thick sand unit above the lowermost shelly till exposed above the beach at the western of the two sections studied. The exposed part of the bone (perhaps a mandible) was quite well preserved and was drier, the part still encased in the sand was wet and more rotten. Collected July 28, 1974 by W. Blake, Jr. at an elevation of 9.0 m.

Comment (W. Blake, Jr.): In view of the dates reported by Krinsley (1963) a 'greater than' age was expected for this sample. Also, the aspartic acid ratio obtained for **Mya truncata** shells (sample BS-74-20) from the underlying till was 0.2924 (UA-1398), a higher ratio than that obtained on sample BS-74-19 (=GSC-2747, this series). The bone was cut up by a hand saw in the field and the bones were transported damp in a plastic bag. The bone was stored frozen in Ottawa, thawed prior to cutting into cubes on a band saw (only the solid outer bone was used) and then dried in an electric oven (the weight decreased from 3633 to 2878 g). The bone was treated with 3N HCl plus a 1 hour NaOH leach, then distilled water rinses; 37.5 g of collagen were burned. Then the KOH method was used (Lowdon et al., 1977). Date is based on one 3-day count in the 5 L counter.

Carey Øer

Isbjørneø series

Marine shells from a section on the southwest coast of Isbjørneø, Carey Øer, Greenland (76°43.5'N, 73°04'W).

GSC-2372. Isbjørneø (I) — 7900 ± 70; $\delta^{13}C = +2.2‰$

Marine pelecypod shells (aragonite; sample BS-76-102; 48.3 g; **Hiatella arctica**; identified by W. Blake, Jr.) from sand at 19.8-20.0 m above high tide level (leveled). Collected August 2, 1976 by R.J. Richardson for W. Blake, Jr. Date is based on one 3-day count in the 5 L counter.

GSC-2374. Isbjørneø (II) — >38 000; $\delta^{13}C = +1.8‰$

Barnacle shell fragments (calcite; sample BS-76-61; 48.2 g; **Balanus balanus**; identified by W. Blake, Jr.) from intact individuals in living position on a single boulder, imbedded in sand, 7.9 m above high tide level (leveled). Collected July 27, 1976 by W. Blake, Jr. Date is based on one 3-day count in the 5 L counter.

GSC-2367. Isbjørneø (III) — 38 300 ± 1100; $\delta^{13}C = +1.7‰$

Marine pelecypod shells (calcite plus <5% of rhodochrosite; sample BS-76-48; 47.0 g; **Chlamys islandica**; identified by W. Blake, Jr.) from sand at 2.4 to 3.3 m above high tide level. Date is based on one 4-day count in the 5 L counter.

Comment (W. Blake, Jr.): GSC-2372 represents the oldest age obtained on Holocene marine pelecypods from Carey Øer. The surface of the boulder beaches, above the shell collection site, is at 23.5 m, and the highest beaches in the vicinity are at 30 m, but the dated shells cannot be related to a specific former position of sea level. The two older age determinations, both from a unit characterized by sand filling the voids between boulders, should both be regarded as minimum ages (Blake, 1977). The D/L ratio for aspartic acid for **Hiatella arctica** shells from the same collection used for GSC-2372 was determined to be 0.09 (UA-1401), and for **Hiatella arctica** shells from the same horizon on which GSC-2367 was determined the ratio was 0.23 (UA-1400). For GSC-2372 the sample consisted of 19 right valves and 8 left valves, although many individuals may have been paired prior to collection. No pitting or encrustations were noticed, although some brownish staining was present. Size range: 4.1 x 2.2 cm to 2.7 x 1.4 cm. For GSC-2374 43 barnacle fragments were used. In size they ranged from 3.4 to 1.8 cm in height. Also, except for seven fragments, all barnacles still retained part of the base plate. For GSC-2367 22 fragments were used for dating.

GSC-2102. 'Markham Beach', Nordvestø — 3460 ± 130; $\delta^{13}C = +1.5‰$

Barnacle fragments (sample BS-74-54; 26.9 g; **Balanus balanus**; identified by E.L. Bousfield, National Museum of Natural Sciences, Ottawa) from an exposure along the east

coast of Nordvestø, Carey Øer, Greenland (76°42.8'N, 73°07'W), at approximately 1.5 m above high tide level. The shells were collected from a fresh exposure in beach sand and gravel above bedrock and approximately 1.0 m below the surface of the cobble beaches. Collected August 9-10, 1974 by W. Blake, Jr.

Comment (W. Blake, Jr.): This sample cannot be related to a specific position of sea level (Blake, 1977), but at the time dating was carried out not a single radiocarbon age determination was available for the Carey Islands. The fragments were well preserved, although no barnacles were found intact and no bases were observed. The calcitic fragments, wet when collected, had a slightly brownish colour, perhaps because of staining by the downward movement of soil humus, or because of algae which appeared to coat some fragments. The sample was air dried. The largest fragments measured 2.6 to 2.0 cm in length. With the barnacles was a vestigial tusk of a narwhal, **Monodon monoceras**; NMC-43811; identified by C.R. Harington, National Museum of Natural Sciences, Ottawa). Date is based on two 1-day counts in the 2 L counter.

GSC-2446. Nordvestø, south coast — 6220 ± 70; $\delta^{13}C = -24.5‰$

Driftwood (sample BS-76-82; 12.0 g; **Picea** sp.; identified by L.D. Farley-Gill) from 0.5 m below the surface of coarse boulder beaches in a reentrant on the south coast of Nordvestø, Carey Øer, Greenland (76°43.0'N, 73°11.5'W), at an approximate elevation of 20 m (altimeter determination). Collected July 30, 1976 by W. Blake, Jr.

Comment (W. Blake, Jr.): The date was obtained on the larger of two pieces of wood (both **Picea** sp.) found on this flight of raised beaches. Unfortunately the elevation of the sample was determined by altimeter on a day when the pressure was changing rapidly. In addition, the southern exposure means that this coast is open to the whole of Baffin Bay (e.g., an enormous fetch), hence the size of the boulders comprising the beaches. The wood, wedged into a void between boulders at the time that it was collected, could have been thrown some distance above the contemporary sea level by wave action. Date is based on two 1-day counts in the 5 L counter.

Nordvestø series

Peat from two sites on Nordvestø, the main (and northwesternmost) island in the Carey Øer, Greenland.

GSC-2415. Nordvestø, north coast (top) — 4390 ± 140; $\delta^{13}C = -22.8‰$

Moss peat (sample BS-76-128A; 9.8 g dry; **Aplodon wormskjoldii**; identified by G.R. Brassard, Memorial University of Newfoundland, St. John's) from 15 to 18 cm depth below the ground surface of a peat mound on the plateau overlooking the north coast of Nordvestø, Carey Øer, Greenland (76°44.2'N, 73°13'W), at an elevation of 140 m (altimeter determination). The sample is from the uppermost 3 cm of the frozen peat, from a large block collected adjacent to a borehole. Collected August 7, 1976 by W. Blake, Jr. and R.J. Richardson.

GSC-2368. Nordvestø, north coast (base) — 6300 ± 80; $\delta^{13}C = -23.5‰$

Moss peat (sample BS-76-128 (253-258 cm); 9.2 g dry; **Aplodon wormskjoldii**; identified by G.R. Brassard) from 253 to 258 cm below the ground surface. The sample represents the basal increment recovered from the borehole, drilled by hand with a modified SIPRE corer. Collected August 9, 1976.

Comment (W. Blake, Jr.): The two determinations show that over 2.5 m of peat accumulated at this site, probably during that part of the Holocene when climatic conditions were optimal. The unusual moss dominating the entire core is one which normally grows on dung or otherwise enriched substrates, and the cliffs to the north may have been nesting sites during the Hysithermal Interval (Brassard and Blake, 1978). The samples were thawed in the field, transported home wet, and then dried in an electric oven in Ottawa. Both samples were treated with NaOH, HCl, and distilled water rinses. GSC-2415 is based on two 1-day counts, GSC-2368 is based on one 3-day count, both in the 2 L counter.

GSC-2558. Nordvestø, central peat mound (top) — 7230 ± 80; $\delta^{13}C = -24.8‰$

Peat (sample BS-76-147; 30.0 g dry) from 15 to 20 cm below the surface of a mound of peat in the central transverse valley (north-south) on Nordvestø, Carey Øer, Greenland (76°43.5'N, 73°11'W), at an elevation of 125 m (altimeter determination). The peat was the uppermost 10 cm of frozen material. Collected August 9, 1976 by W. Blake, Jr. and R.J. Richardson.

GSC-2440. Nordvestø, central peat mound (base) — 8940 ± 90; $\delta^{13}C = -24.3‰$

Basal organic detritus (sample BS-76-121 (99-104 cm); 46.7 g dry) from 99 to 104 cm depth in a borehole drilled by hand in the same peat mound with a modified SIPRE corer. The dated material is from the top half of this core increment, as the lowermost part was nearly pure ice (Brassard and Blake, 1978). Collected August 4, 1976.

Comment (W. Blake, Jr.): The dates show that peat accumulated at this site for the better part of 3000 years, for there was 15 cm of peat (unfrozen) above the 5 cm increment used for GSC-2558. GSC-2440 is the oldest Holocene date available from Carey Øer, and it indicates that any cover of glacier ice had disappeared before 10 000 BP. Both samples were treated with NaOH, HCl, and distilled water rinses. Each date is based on two 1-day counts in the 5 L counter.

Olrik Fjord

Olrik Fjord series

Marine pelecypod shells were collected from a site 4 to 5 km east of the western end of Kûgssuaq on the north shore of Olrik Fjord, North Greenland (77°12'N, 67°27'W), at an elevation of 28 m. The shells occurred in nearly horizontal lenses and layers, 2 to 5 cm thick, of grey silt within a till-like silt containing numerous rounded boulders of gneiss and sandstone/quartzite. The base of the cliff where the beds were exposed is at an elevation of 25 m, the top is at 35 m. The unit exposed at the top of the cliff is 1 to 2 m of gravel which is underlain by sandy transitional layers to the underlying till-like, boulder-rich silt (Weidick, 1978a,b). Collected July 15, 1976 by A. Weidick, Grønlands Geologiske Undersøgelse, Copenhagen, Denmark.

GSC-2426. Olrik Fjord (I) — >33 000; $\delta^{13}C = +1.1‰$

Marine pelecypod shells (sample GGU-226427; 15.3 g; **Chlamys islandica**; identified by A. Weidick) from the shell-rich lenses at 28 m. Because of the small sample size, only the outer 10% of shell material was removed with HCl leach. Sample was mixed with dead gas for counting. Date is based on one 4-day count in the 2 L counter.

GSC-2497. Olrik Fjord (II) >37 000
$\delta^{13}C = +1.8‰$

Marine pelecypod shells (sample GGU-226427; 27.0 g; **Hiatella arctica**; identified by A. Weidick) from the same unit as the **Chlamys islandica** used for GSC-2426. Date is based on two 1-day counts in the 2 L counter.

Comment (W. Blake, Jr.): The site was visited in 1976, the new collections made, and these two age determinations carried out, because a rather unexpected date was obtained on a mixed collection of **Chlamys islandica, Hiatella arctica,** and **Mya truncata** made by P.R. Dawes at a site 14 km further east in the fiord and only 2.5 m above sea level. The result on this sample was 18 990 ± 280 years (I-8894; Weidick, 1976a,b). A series of Holocene-age dates were obtained from collections between 6 and 21 m in the same area. If I-8894 represents the true age of the deposit, the implication is "an extent of the Inland Ice less than 35 km beyond its present extent within at least the last 19 000 years" (Weidick, 1976a). This date is also similar to one of 20 800 ± 2900 years (I-2322) reported from buried organic matter in Inglefield Land, albeit on a sandy clay which contained only 1.6% organic matter (Tedrow, 1970). In spite of the extremely low organic content this date is often cited as indicating ice free conditions (cf. Boulton, 1979). Thus it was deemed important to try to check the age of the 'old' shells in Olrik Fjord. It is unfortunate that the collection made in 1976 were not from exactly the same site as the 1974 collection, but at least it is now clear that shells more than 33 000 years old are present, in a till-like material, to the west of the site where the original collection was made.

The fragmented **Chlamys islandica** valves used for GSC-2426 consisted of six hinge fragments plus 15 other fragments, all recognizable as **Chlamys** by their colour and ornamentation. Their composition, as determined by X-ray diffraction, was calcite plus traces of aragonite and rhodochrosite. No fragment was greater than 5 cm in height. A little adhering silt was removed by brushing. One fragment of **Clinocardium ciliatum** in the sample was not used. In the case of GSC-2497 the sample submitted consisted only of whole valves of aragonitic **Hiatella arctica.** This included three probable pairs plus five valves, three left and two right. The largest valve measured 3.9 x 2.0 cm. The shells were chalky, exhibited some pitting, and some were characterized by thin spots of secondary precipitates on internal surfaces.

Inglefield Land

GSC-3888. Littleton Ø 36 700 ± 1990
$\delta^{13}C = -2.4‰$

Marine pelecypod shells (sample 84-85-57; 11.0 g; **Macoma calcarea**; identified by W. Blake, Jr.) from a coastal exposure of fine sand and silt in front of (west of) a dissected delta. The site is at a harbour 2.7 km northeast of Littleton Ø, Inglefield Land, Greenland (78°21.8'N, 72°45'W), at an elevation of 3 to 5 m. Collected June 9, 1984 by W. Blake, Jr. and K.E. Rolko.

Comment (W. Blake, Jr.): It was hoped that the date would provide an approximate age for the Holocene deglaciation, but the shells obviously relate to an earlier marine incursion. The date on these aragonitic shells should be regarded as a minimum value. The sample was composed of some whole shells plus many fragments. The largest whole shell measured 3.2 x 2.3 cm, but some of the fragments were from larger individuals. Some iron-staining existed, many fragments retained the periostracum, and in two cases the ligament was still holding the valves together. Encrusted shells were omitted. The fragile shells (all less than 1 mm thick, and some less than 0.5 mm) did not retain internal lustre. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Date is based on one 3-day count in the 2 L counter.

GSC-3883. Refuge Harbour 6480 ± 70
$\delta^{13}C = +0.9‰$

Intact cirripeds (sample 84-BS-99; 47.0 g; **Balanus balanus**; identified by W. Blake, Jr.) on cobbles and boulders in sand and gravel foreset beds in the delta at the head of Refuge Harbour, Inglefield Land, Greenland (78°27.2'N, 72°37.5'W), at an elevation of 13 m (altimeter determination). All the barnacles were in living position. Collected June 13, 1984 by W. Blake, Jr. and K.E. Rolko.

Comment (W. Blake, Jr.): It was hoped that the age of these well preserved calcitic shells would be closer to the time of deglaciation, estimated to be in the range of 9000 to 7500 years in this area (cf. GSC-3732, Blake et al., 1985; this list). Date is based on one 4-day count in the 5 L counter.

Kap Inglefield Sø series

Organic lake sediments were obtained by coring in the southwest part of a lake informally named 'Kap Inglefield Sø', approximately 2 km southeast of Kap Inglefield, Inglefield Land, northwestern Greenland (78°31.8'N, 72°21.0'W), at an elevation of 150 m (altimeter determinations). A 49 cm-thick organic sequence is underlain by banded sediment (sand alternating with clay/silt) which probably was deposited in an ice-dammed lake. The sampling was done from the surface of the frozen lake (1.65 m of ice); water depth under the ice was 3.95 m. Collected June 8, 1980 with a modified Livingstone sampler by S. Funder (Geological Museum, University of Copenhagen, Copenhagen, Denmark), T.W. Anderson, and W. Blake, Jr.

GSC-3857. Kap Inglefield Sø, 3-7 cm 4170 ± 150
$\delta^{13}C = -25.9‰$

Organic lake sediment (sample BS-80-18 (1: 3-7 cm); 70.0 g wet) from 3 to 7 cm below the sediment/water interface. Organic carbon content: 10.7% at 5 to 6 cm.

GSC-3821. Kap Inglefield Sø, 17-21 cm 4980 ± 120
$\delta^{13}C = -24.2‰$

Organic lake sediment (sample BS-80-18 (1: 17-21 cm); 65.0 g wet) from 17 to 21 cm below the sediment/water interface. Organic carbon content: 10.2% at 15 to 16 cm, 7.2% at 20 to 21 cm.

GSC-3820. Kap Inglefield Sø, 30-36 cm 6020 ± 110
$\delta^{13}C = -23.0‰$

Organic lake sediment (sample BS-80-18 (1: 30-36 cm); 60.0 g wet) from 30 to 36 cm below the sediment/water interface. Organic carbon content: 10.5% at 30 to 31 cm, 7.6% at 35 to 36 cm.

GSC-3732. Kap Inglefield Sø, 45-49 cm 7210 ± 130
$\delta^{13}C = -27.2‰$

Basal organic lake sediment (sample BS-80-18 (1: 45-49 cm); 5.0 g damp plus 60.0 g wet) from 45 to 49 cm below the sediment/water interface. Organic carbon content: 11.3% at 45 to 46 cm, 6.2% at 48 to 49 cm.

Comment (W. Blake, Jr.): GSC-3732 provides a minimum date for deglaciation. With regard to elements of the fossil flora and fauna, "Only 20 diatom species were recorded in the organic sequence, and of these only five taxa were ever present at greater than trace levels (i.e., 2% of the total diatom sum). The diatom assemblage was dominated by small **Fragilaria** species (i.e., **F. construens, F. construens**

var. **venter**, **F. pinnata**), with lesser amounts of **Cymbella minuta**. These diatoms are typical of early postglacial environments from most glaciated lakes, regardless of location or geologic substrate. Their continued abundance throughout the history of this lake reflects the extreme climate of the region. These harsh conditions are also reflected in the fossil Cladocera (Crustacea), as the remains of only **Chydorus sphaericus** were recorded. Fragments of mosses occurred throughout the organic sequence; **Calliergon giganteum** dominated at most levels between 5 and 49 cm except at the 30-31 cm interval, where **Drepanocladus revolvens** was the only identifiable species, and at 15-16 and 20-21 cm, where the latter species was the most abundant. A pollen- and microfossil diagram can be divided into five zones. 0-6 cm: **Saxifraga oppositifolia** zone with many pioneer (fell-field) plants. Up to 250 000 **Pediastrum**/ml indicate a very slow sedimentation rate, as do the age determinations, possibly caused by a nearly permanent ice cover over the central part of the lake. 6-32 cm: Cyperaceae zone with some **Salix arctica** and **Dryas**. 32-50 cm: **Salix arctica** zone with high pollen influx. 50-61 cm: **Salix**-Polypodiaceae zone with many pioneer plants. 61-106 cm: Poaceae-pioneer plant zone. The minerogenic sediment, rich in rebedded pollen, is lacking in contemporary algae and zoological remains, whereas their number varies throughout the organic part of the core, giving some indication of climatic and trophic fluctuations" (Blake et al., 1985). NaOH leach was omitted from the pretreatment of all four samples, and none reacted with HCl. GSC-3732 and -3820 are each based on one 3-day count in the 2 L counter. GSC-3821 and -3857 are each based on two 1-day counts in the 2 L counter.

GSC-3884. Force Bugt >34 000
$\delta^{13}C = -0.7‰$

Marine pelecypod shells (sample 84-BS-102; 10.3 g; **Mya truncata**; identified by W. Blake, Jr.) from a section a few tens of metres inland from the coast on the north side of Force Bugt, Inglefield Land, Greenland (78°32.2'N, 71°54'W), at an elevation of 8 m (altimeter determination). Collected June 14, 1984 by W. Blake, Jr. and K.E. Rolko.

Comment (W. Blake, Jr.): It was hoped that the age of these shells would bear on the time of Holocene deglaciation in an area where no ^{14}C dates were previously available (cf. Nichols, 1969; Blake et al., 1985). The result indicates that the fauna relates to a previous marine incursion. The aragonitic shells were well preserved. No chalkiness or encrustations were noted. Over half of the valves (all fragments are less than 2 cm in the largest dimension) have retained some periostracum. Some valves exhibited iron staining and some still had internal lustre. Most of the shell material was less than 1 mm in thickness, all were less than 2 mm. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Date is based on one 3-day count in the 2 L counter.

Washington Land

Benton Bugt Series

Marine pelecypod shells from two sites in a valley east of Benton Bugt, Washington Land, Greenland. The sites are 2 km north of Humboldt Gletscher (Weidick, 1977). Collected July 14, 1975 by N. Henriksen and J. Peel, Grønlands Geologiske Undersøgelse, Copenhagen, Denmark; submitted by A. Weidick of the same organization.

GSC-2707. Benton Bugt, 37 ± 5 m 5450 ± 100
$\delta^{13}C = +1.2‰$

Marine pelecypod shells (sample GGU-212801; 15.5 g; **Mya truncata**; identified by A. Weidick and W. Blake, Jr.) in gravel and sand from 5 to 10 m below a terrace surface, in the valley east of Benton Bugt (79°54'N, 64°05'W), at an elevation of 37 ± 5 m (altimeter determination).

Comment (W. Blake, Jr.): These well preserved aragonitic shells, some of which were in living position, probably provide an approximate age for the terrace surface. The date also indicates that the Humboldt Gletscher has not advanced northward a significant amount (beyond its present position) in the last 5500 years. Well preserved **Hiatella arctica** shells were also present in the collection, plus three valves of **Macoma calcarea**, although neither species was used for dating. The sample submitted consisted of five left valves plus five right valves (not pairs) of **Mya truncata**. The largest was 4.1 x 3.1 cm, the smallest was 2.5 x 2.0 cm. None of the shells were thick or robust, and the smaller shells were thinner. No pitting was present, but a few traces of secondary carbonate precipitates were noted. Most shells had traces of the periostracum, no lustre, some chalkiness and some Fe-staining. Heavily stained and encrusted shells were not used. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on two 1-day counts in the 2 L counter.

GSC-2370. Benton Bugt, 55 m 6400 ± 100
$\delta^{13}C = +1.6‰$

Marine pelecypod shells (sample GGU-21288; 10.45 g; **Mya truncata**; identified by A. Weidick and W. Blake, Jr.) from a sand/silt unit with irregular pebbles. This sample is from the surface (collecting was done over a 20 x 20 m area) of the highest terrace seen in this valley east of Benton Bugt (79°54'N, 63°58'W), at an elevation of 55 m (altimeter determination).

Comment (W. Blake, Jr.): As the well preserved aragonitic shells, some of them in situ, were the highest found in the area, they provide an age estimate for a position of the sea at approximately 55 to 60 m, relative to the land. Although **Hiatella arctica** was also present in the sample, only **Mya truncata** was used for dating; three left valves and two right valves, all whole, were submitted. Traces of periostracum remained on several, and all except the largest valve (4.1 x 3.2 cm) retained internal lustre. Several also had traces of thin secondary precipitates. Because of the small sample size, only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter. The uncorrected date (6370 ± 100 BP) was reported by Weidick (1977).

GSC-2334. Cass Fjord 5980 ± 70
$\delta^{13}C = +1.7‰$

Marine pelecypod shells (sample GGU-212973; 26.3 g; **Hiatella arctica**; identified by A. Weidick) from clay in a terrace at the head of the inner eastern branch of Cass Fjord, Washington Land, Greenland (81°07.5'N, 63°35'W), at an elevation of 46 m (hand-leveling). Collected August 16, 1975 by H. Henriksen, J. Peel, and S. Watt, all of Grønlands Geologiske Undersøgelse, Copenhagen, Denmark; submitted by A. Weidick of the same organization.

Comment (W. Blake, Jr.): The dated shells probably relate to a terrace surface at an elevation of approximately 50 m. A little silt remaining on these well preserved,

frequently paired, aragonitic shells was scraped off. Most retained internal lustre, and the shells had no secondary precipitates or pitting, the periostracum was generally lacking. The sample submitted consisted of 13 left valves and 10 right valves; none were thick and all ranged between 4.0 and 2.6 cm in length. One fragment of **Mya** sp. was in the collection but was not used for dating. Date is based on one 3-day count in the 2 L counter. The uncorrected date (5950 ± 70 BP) was reported by Weidick (1977).

Daugaard-Jensen Land

GSC-2447. Daugaard-Jensen Land >51 000

Driftwood (sample GGU-206054; 22.0 + 20.8 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 77-2 by L.D. Farley-Gill) from the interior of Daugaard-Jensen Land, north of Humboldt Gletscher, North Greenland (80°06.8'N, 61°40'W), at an elevation in the range of 245 to 260 m. The wood was one of many pieces scattered along a river bed in a valley. Collected August 1, 1976 by H. Jepsen, submitted by A. Weidick, both of Grønlands Geologiske Undersøgelse, Copenhagen, Denmark. Two determinations were made:

GSC-2447. First determination >40 000

Date is based on one 1-day count in the 5 L counter.

GSC-2447. Second determination >51 000

After the usual treatment for high pressure samples with NaOH, HCl, and distilled water rinses, the CO_2 was purified using the KOH method (Lowdon et al., 1977). Date is based on one 5-day count in the 5 L counter.

Comment (W. Blake, Jr.): The wood is interpreted by the submitter as being of interglacial age, later redeposited by glacier action (Weidick, 1978a, 1978b).

Svalbard

Nordaustlandet

GSC-2736. Wahlenbergfjorden 9670 ± 140
$\delta^{13}C = +3.6‰$

A marine pelecypod shell (sample WB-187-66; 12.05 g; **Mya truncata**; identified by W. Blake, Jr.) from a gully on the north side of the head of Wahlenbergfjorden, Nordaustlandet, Svalbard (79°48.5'N, 21°58'E), at an elevation of 43 m (altimeter determination). The shells were collected over a vertical interval of about 3.5 m in the gully, approximately 5 m below the surface of a prominent terrace. Collected August 25, 1966 by W. Blake, Jr.

Comment (W. Blake, Jr.): The shells were dated as part of a series of inter-laboratory checks, after a number of anomalous results were received from the ^{14}C laboratory at Gakushuin University, Tokyo, Japan (cf. Blake, 1980b). The Gakushuin result on a 47 g sample of **Mya truncata** from the same collection was 8190 ± 170 years (GaK-1406; personal communication from K. Kigoshi, 1967), but the GSC result agrees more closely with the regional picture based on other dates obtained from around Nordaustlandet (Blake, 1961; Knape, 1971; Salvigsen, 1978, 1979; Häggblom, 1982; Jonsson, 1983). The dated sample may relate to the time of formation of the Holocene marine limit, at approximately 66 m in the vicinity. To avoid any problem with mixing of shells of different ages, the sample submitted to the GSC laboratory was a single right valve, 5.0 x 4.4 cm in size. A bit of periostracum remained but no lustre was noted and both the internal and external surfaces of the aragonitic shell were somewhat chalky. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

GSC-3490. Sveanor 9420 ± 100
$\delta^{13}C = -25.7‰$

Driftwood log (sample WB-27-1958; 11.7 g dry; **Larix** sp.; unpublished GSC Wood Identification Report No. 82-25 by R.J. Mott), from beach sand and gravel 1 km east of Sveanor on the south side of Murchisonfjorden, Nordaustlandet, Svalbard (79°56'N, 18°22'E), at an elevation of 36.5 m. Collected August 16, 1958 by W. Blake, Jr. Other GSC age determinations on Svalbard driftwood are reported in GSC XI (1971, p. 318-319), GSC XX (1980, p. 22-23), and GSC XXV (1986a, p. 27).

Comment (W. Blake, Jr.): This well preserved, partly imbedded log was the highest found in northwestern Nordaustlandet. It was first discovered in 1931 by members of the "Swedish-Norwegian Arctic Expedition in the summer of 1931" (Kulling and Ahlmann, 1936). The GSC age determination is virtually identical with a date on the same log of 9400 ± 140 BP (U-70, corrected to the NBS oxalic acid standard; personal communication from I.U. Olsson, 1966) determined by the Uppsala ^{14}C laboratory and first reported as 9270 ± 130 BP using a Swedish oak standard (Uppsala I, 1959, p. 91; Blake, 1961, 1962; Olsson and Blake, 1962). The sample was broken up and dried in an electric oven in the field. When being prepared for dating in Ottawa all outside wood and wood along splits was scraped off. No mold was present. Date is based on one 4-day count in the 5 L counter.

GSC-2669. Rijpdalen 9100 ± 140
$\delta^{13}C = +0.3‰$

Marine pelecypod shells (sample WB-120-66; 26.9 g; **Mya truncata**; identified by W. Blake, Jr.) from fine sand in an exposure on the east side of the river flowing north to the bay at the extreme south end of Rijpfjorden, Nordaustlandet, Svalbard (79°58'N, 22°18'E), at an elevation of 32 to 36 m (altimeter). Collected August 7, 1966 by W. Blake, Jr.

Comment (W. Blake, Jr.): This sample was dated to provide a minimum age for deglaciation of the northern part of Rijpdalen (Blake, 1981c) and as an inter-laboratory check. **Mya truncata** shells (47 g) from the same collection had earlier been dated at Gakushuin University, and the result was 9200 ± 180 years (Gak-1915; personal communication from K. Kigoshi, 1968), so in this case the agreement was reasonable. Other species present in the deposit are **Hiatella arctica** and **Macoma calcarea**. The sample used for GSC-2669 was both whole valves and fragments. All of the aragonitic shell material was thin but well preserved. Date is based on one 3-day count in the 2 L counter.

GSC-1943. Søre Franklinbreen (I) 16 700 ± 270
$\delta^{13}C = +2.1‰$

Fragments of marine pelecypod shells (sample WB-167-66; 9.6 g; **Mya truncata** and **Hiatella arctica**) from the surface and imbedded at shallow depth in till of a moraine separating Søre Franklinbreen from a lobe of Vestfonna, approximately 6 km southeast of the glacier front at the head of Lady Franklinfjorden, Nordaustlandet, Svalbard (80°03'N, 19°30'E), at an elevation of 125 to 130 m (altimeter determination). Collected August 23, 1966 by W. Blake, Jr.

Comment (W. Blake, Jr.): In view of the rather surprising age obtained and the fragmented and worn nature of the shells (rounded corners), it seems likely that the submitted sample was a mixture of 'old' shells and Holocene shells. 'Old' shells are common on the south side of Søre Franklinbreen (cf. Uppsala I, 1959, p. 91; Uppsala II, 1960, p. 119-121; Blake, 1961, 1962; Olsson and Blake, 1962), and at another site, near the mouth of Lady Franklinfjorden, shells collected from till on two occasions have given similar anomalous ages (U-263; Uppsala IV, 1964, p. 299; U-646 and

U-2060, Uppsala IX, 1969, p. 524-525). If indeed Holocene shells are present, the snout of Søre Franklinbreen must have been more than 6 km southeast of its present position sometime during the last 10 000 years. This change in the position of the glacier is also indicated by the presence of well developed raised beaches, of Holocene age, along the southeast side of Søre Franklinbreen. These beaches could not have developed with the glacier in its present position. Date GSC-3806 (1100 ± 60 years, this list) suggests that an advance of Søre Franklinbreen has occurred during the last 1040 to 1060 radiocarbon years. Of the shell fragments making up the collection on which GSC-1948 is based, one large piece of **Mya truncata** retained some periostracum. The shells were damp when collected. Because of the small sample size, only the outer 10% of the shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Søre Franklinbreen series

Driftwood from three adjacent sites on the Neoglacial lateral moraine ridge along the southwest side of Søre Franklinbreen, Nordaustlandet, Svalbard (80°04'N, 19°20'E). Two of the three pieces were dated as inter-laboratory checks with Gakushuin University, Tokyo, Japan.

GSC-3735. Søre Franklinbreen (I) — 1830 ± 50; $\delta^{13}C = -25.6‰$

Driftwood (sample WB-15-1958; 11.1 g dry; **Larix** sp.; unpublished GSC Wood Identification Report No. 84-15 by R.J. Mott) half-imbedded in till on a flat area between Søre Franklinbreen and its lateral moraine, approximately 1 km "up-glacier" from the sea. It is close to the site at which wood WB-4-1957 (GSC-3838, 1810 ± 60 BP, this series) was found. Collected July 25, 1958 by W. Blake, Jr. Gakushuin age: 2600 ± 80 years (Gak-1910; personal communication from K. Kigoshi, 1968).

GSC-3806. Søre Franklinbreen (II) — 1100 ± 60; $\delta^{13}C = -25.9‰$

Driftwood (sample WB-16-1958; 11.7 g dry; **Larix** sp.; unpublished GSC Wood Identification Report No. 84-15 by R.J. Mott) on the ground surface on the distal side of the main moraine ridge, facing the raised beaches, and approximately 1 km "up-glacier" from the sea. Collected July 25, 1958 by W. Blake, Jr. Gakushuin age: 1340 ± 90 years (Gak-1911, personal communication from K. Kigoshi, 1968).

GSC-3838. Søre Franklinbreen (III) — 1810 ± 60; $\delta^{13}C = -24.2‰$

Driftwood (sample WB-4-1957; 11.2 g dry; **Larix** sp.; unpublished GSC Wood Identification Report No. 84-14 by R.J. Mott) lying across its own imprint on the till surface between Søre Franklinbreen and its lateral moraine, close to the site at which WB-15-1958 (GSC-3735, 1830 ± 50 BP, this series) was found. Collected September 6, 1957 by W. Blake, Jr.

Comment (W. Blake, Jr.): As the ages of GSC-3735 and -3838 are virtually identical, the samples were found close together in the field, and they are both **Larix** sp., there is a possibility that they derived from the same driftwood log, although this is by no means a certainty. The critical sample here is the younger wood, GSC-3806 (1100 ± 60 years), for it shows that the advance has occurred sometime since 1040 to 1160 radiocarbon years ago, as is the case with the northern arm (Nordre Franklinbreen) of the same glacier (cf. GSC-3500, 1120 ± 60 years, this list). Each date is based on two 1-day counts in the 5 L counter.

GSC-3500. Nordre Franklinbreen — 1120 ± 60; $\delta^{13}C = -24.1‰$

Driftwood log (sample WB-18-66; 11.9 g dry; **Larix** sp.; unpublished GSC Wood Identification Report No. 82-30 by R.J. Mott) from the till surface on the proximal side of a Neoglacial lateral moraine ridge on the northwest side of Nordre Franklinbreen, Nordaustlandet, Svalbard (80°08.5'N, 19°26'E), at an elevation of 8 m (altimeter determination). Collected July 14, 1966 by W. Blake, Jr.

Comment (W. Blake, Jr.): This sample was dated as an inter-laboratory check. An earlier determination, at Gakushuin University, Tokyo, on wood from the same log had given a result of 2400 ± 140 years (Gak-1334, personal communication from K. Kigoshi, 1967). The GSC determination shows that this glacier has advanced sometime during the last 1060 to 1180 radiocarbon years (cf. GSC-3806, 1100 ± 60 years, this list). Pieces of this well preserved, but splintered log was scraped individually to remove adhering silt and clay. Date is based on two 1-day counts in the 5 L counter.

GSC-2145. Lindhagenbukta — 0 ± 40

Paired marine pelecypod shells (sample WB-71-66; 47.7 g; **Astarte borealis**; identified by W. Blake, Jr.) from the surface of the modern storm beach at the head of Lindhagenbukta, Nordaustlandet, Svalbard (80°17'N, 20°42'E), at an elevation of 0 to 2 m. Collected July 25, 1966 by W. Blake, Jr.

Comment (W. Blake, Jr.): The sample was dated as a laboratory cross-check. Other paired valves of **A. borealis** (mistakenly listed by W.B., Jr. as **Macoma calcarea**) with intact periostracum from the same collection were dated earlier at the Uppsala ^{14}C laboratory. The dates were 380 ± 90 years (U-2059) and 410 ± 90 years (U-2058) for the outer and inner fraction of shells, respectively, and if the pelecypods are assumed to have been living in 1960, the apparent age of the sea water is 420 years (Uppsala IX, 1969, p. 524; Mangerud, 1972). The Uppsala dates are corrected to a base of -25.0‰, so the agreement with the result for GSC-2145, corrected to 0‰, is excellent. The submitted sample consisted of 15 intact pairs plus 14 valves (sizes between 2.8 to 1.6 cm in length, 2.2 to 1.4 cm in height). All retained the ligament, some periostracum, and internal lustre. Date is based on one 3-day count plus two 1-day counts in the 5 L counter.

GSC-2729. Dalvägen — 9670 ± 200; $\delta^{13}C = +2.6‰$

Marine pelecypod shells (sample WB-41-66; 10.25 g; **Chlamys islandica**; identified by W. Blake, Jr.) from a stream cut in sandy nearshore deposits to the east of an end moraine at the snout of an unnamed valley glacier in Dalvägen, Nordaustlandet, Svalbard (80°27.5'N, 19°52'E), at an elevation of 18 m (leveled). The collection site was 2 to 3 m below the surface of the raised beaches. Collected July 20, 1966 by W. Blake, Jr.

Comment (W. Blake, Jr.): The sample was dated to obtain information on the time at which the area became free of glacier ice (cf. Blake, 1981c) and to check on a Gakushuin University date. The sample submitted to Gakushuin was 41 g of small, thin, and somewhat chalky shells of **Hiatella arctica** from the same collection; the result was 10 160 ± 240 years (Gak-1330, personal communication from K. Kigoshi, 1967). In addition to **H. arctica** and **C. islandica** the collection contained **Mya truncata**, **Balanus** sp., echinoid spines and bryozoa on rock fragments. The two valves used, from a single pair, were 7.2 cm high, 7.5 cm wide. The inner nacreous layer of shell material was aragonite plus approximately 25% of calcite, the outer

portion of the shells was calcite plus about 5 to 10% each of quartz and rhodochrosite, as determined by X-ray diffraction. Because of the small sample size only the outer 10% of shell material was removed by HCl leach. Sample was mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Union of Soviet Socialist Republics

Tomskaya Oblast

GSC-2905. Krasnyi Yar — 29 500 ± 450; $\delta^{13}C = -23.7‰$

Wood (sample FI-IGCP-78; 11.8 g; **Picea** sp.; unpublished GSC Wood Identification Report No. 78-33 by R.J. Mott) from a stump in growth position excavated from silty sand in the right bank of the Ob River, 18 km north of Novosibirsk at Krasnyi Yar, Tomskaya Oblast, USSR (55°15'N, 82°45'E), at an elevation of approximately 100 m. The wood-bearing silt was overlain by a loess unit and by lacustrine sands, together totalling 20 m. Below the stump was approximately 13 m of sand with peat stringers to river level. Collected July 21, 1978 by R.J. Fulton.

Comment (W. Blake, Jr.): This wood was processed at the GSC as part of a series of dates being determined at different laboratories – Stockholm, Sweden; Vilnius, Lithuanian SSR, and Trondheim, Norway. All determinations were on the same stump. Other results are as follows: 28 245 ± 835 BP (St-6678), 30 720 ± 1200 BP (Vs-259), and 29 200 ± 700 BP (T-3024), so agreement is reasonably good (Arkhipov et al., 1982). In addition, numerous radiocarbon age determinations in the range of 26 000 to 34 000 BP had been reported previously on wood from the same horizon from which the present stump was derived, as well as from lower in the section (Volkov and Arkhipov, 1978).

The well preserved but irregularly shaped dark brown root measured 24 cm and 19 cm along two sides and was up to 2 cm thick. Oven drying reduced its weight from 119 to 83.3 g. A few adhering rootlets were removed. The sample was given the normal leaches in NaOH and HCl plus distilled water rinses. Date is based on one 3-day count in the 5 L counter.

Estonian SSR

Karuküla series

Wood and peat were collected from a freshly excavated pit in farm land approximately 7 km south of the village of Kilingi-Nõmme, Estonian SSR, USSR (58°04'N, 25°00'E). Collected August 16, 1973 by J-M. Punning, Institute of Geology, Academy of Sciences of the Estonian SSR, Tallinn, and W. Blake, Jr.

GSC-1976. Karuküla, wood — 48 700 ± 1600; $\delta^{13}C = -23.6‰$

Wood (sample BS-73-40; 43.0 g dry; **Pinus** sp. (not **Pinus sylvestris**); unpublished GSC Wood Identification Report No. 73-57 by L.D. Wilson) from peat unit 160 to 170 cm below the surface.

GSC-1985. Karuküla, peat — >46 000; $\delta^{13}C = -28.3‰$

Peat (sample BS-73-41; 77.0 g dry) from 180 to 190 cm below the surface. Although the peat contained mainly indeterminable remains (unpublished GSC Bryological Report No. 267 by M. Kuc), it was described as a strongly compressed rhizome moss peat. Of the identifiable remains: **Carex** sp. rhizomes and mosses – **Drepanocladus revolvens, D.** sp., **Calliergon giganteum, C.** sp., **Sphagnum** (at least three species), **Tomenthypnum nitens**, and **Meesea triquetra** were present.

Comment (W. Blake, Jr.): Numerous radiocarbon age determinations from Karuküla published prior to the time that the collections were made in 1973, are summarized in Blake (1975c), and other determinations are listed by Raukas (1978). Although there has been some disagreement as to the age of the deposits at Karuküla "on purely botanical grounds, a recent summary by Serebryanny et al. (1981, p. 78) states "...all the results of paleobotanical research and other methods (radioisotope chronology, lithology) point to the young age of this flora. So these data support the mention that the lacustrine and bog deposits of the Karuküla section were accumulated during the last interglacial in the Pleistocene history of the Russian plain. This interglacial was younger than the Mikulino interglacial."

The pretreatment of both GSC-1976 and -1985 included a 1 hour leach with hot NaOH, a 1-hour leach with hot HCl, and distilled water rinses. The samples were counted in the 5 L counter at 4 atmospheres. The 8-day count for GSC-1976 was broken down into several individual counts, for which ages can be calculated as follows: 47 800 ± 1000 years (one 3-day count); 51 200 ± 1600 years (one 2-day count); and 45 500 ± 1200, >46 000, and 46 200 ± 1300 years (one 1-day count each). The 5-day count for GSC-1985 can be broken down as follows: 51 800 ± 1500 years (one 3-day count); and >48 000 and >45 000 years (one 1-day count each)." (Blake, 1975c, p. 124).

Murmansk Oblast

Kuzreka series

Wood and marine shells from a section exposed along a river approximately 2.0 km north of the hamlet of Kuzreka, Umba District, Murmansk Region, Kola Peninsula, U.S.S.R. (66°39'N, 34°48'E). Shells collected August 9 and 11, 1973 by the late S.A. Strelkov, Institute of Geology, Academy of Sciences of the USSR, Apatity, Murmansk Oblast, M.G. Grosswald, Institute of Geography, Academy of Sciences of the USSR, Moscow, USSR, and W. Blake, Jr.; wood collected August 8, 1973 by W. Blake, Jr.

GSC-1967. Kuzreka (I) — 8030 ± 90; $\delta^{13}C = -0.5‰$

Marine pelecypod shells (sample BS-73-19; 27.0 g; **Astarte borealis**; identified by W. Blake, Jr.) in moist sandy silt at an elevation of approximately 5.0 m. The sample was composed of 20 intact pairs; all had some or nearly all of the periostracum intact (but were somewhat worn in the hinge area), and most retained good internal lustre. Date is based on two 1-day counts in the 2 L counter.

GSC-2021. Kuzreka (II) — 9750 ± 630; $\delta^{13}C = -26.5‰$

A single twig (BS-73-19(A); 0.9 g; angiospermous wood, but too strongly compressed to identify; unpublished GSC Wood Identification Report No. 74-11 by R.J. Mott) in shell-bearing sandy silt at an elevation of approximately 5.0 m. The wood was wet when collected; after some natural drying its dimensions were: 11.5 cm long by 1.0 cm maximum diameter. Later the sample was oven-dried and adhering silt (plus some bark) was removed by scraping. Sample was mixed with dead gas for counting. Date is based on one 5-day count in the 2 L counter.

GSC-1961. Kuzreka (III) 8800 ± 100
$\delta^{13}C = -1.6‰$

Marine pelecypod shells (sample BS-73-36; 23.2 g; **Mytilus edulis**; identified by W. Blake, Jr.) from clayey silt at an elevation of less than 3.0 m. The sample was 1.05 to 1.25 m below the level at which the shells for GSC-1967 were extracted, 0.4 to 1.0 m above river level (variation is because of dipping strata), and approximately 2.0 m above a boulder and gravel unit interpreted as being outwash. The shells were thin and fragile; some were paired, but it was not possible to extract any whole. No fragments exceeded 2 cm in largest dimension, but most shells had intact periostracum. Sample mixed with dead gas for counting. Date is based on one 3-day count in the 2 L counter.

Comment (W. Blake, Jr.): If the age of GSC-2021 is correct at the stated value or on the plus side of the error term, it would be one of the oldest Holocene dates from the White Sea region (cf. MGU-IOAN-27, 9330(9530) ± 120 BP; shells in the sea bottom off the Solovetskiy Archipelago; Kaplin et al., 1971; Grosswald, 1972; Blake, 1974b; Evzerov and Koschechkin, 1977). If the age of the basal clay/silt is really close to 9000 radiocarbon years (somewhat younger if a correction is applied for the apparent age of marine shells), it is still one of the oldest Holocene marine units along the Gulf of Kandalaksha (cf. Koshechkin et al., 1976).

GSC-2000. Varzuga >43 000
$\delta^{13}C = +1.9‰$

Marine pelecypod shells (sample 13S-73-20; 27.0 g; **Mytilus edulis**; identified by W. Blake, Jr.) from compact clayey silt exposed beside Varzuga River 2 to 3 km downstream (southeast) from the hamlet of Varzuga, Murmansk District, U.S.S.R. (66°24'N, 36°38'E). The shells, some of which were whole at the time of collection, were extracted from blocks cut from the flat surface within 30 to 50 cm of river level. Collected August 9, 1973 by W. Blake, Jr., S.A. Strelkov, M.G. Grosswald, and N.S. Dedkov (the last-named also at the Institute of Geology, Academy of Sciences of the USSR, Apatity, Murmansk Oblast).

Comment (W. Blake, Jr.): The date, as expected, shows that the marine deposits at river level near the hamlet of Varzuga belong to an older (pre-Holocene) generation (cf. Evzerov et al., 1972; Blake, 1974b; Evzerov et al., 1976). Date is based on one 4-day count in the 2 L counter.

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